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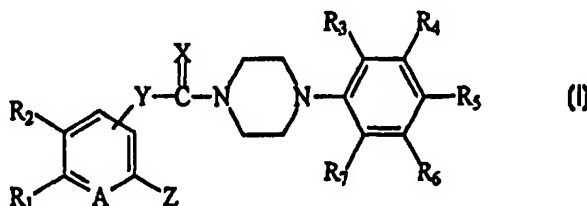
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: PIPERAZINE DERIVATIVES AND PROCESS FOR THE PREPARATION THEREOF

## (57) Abstract

The present invention relates to novel compound having strong antitumor activities of general formula (I), wherein R<sub>1</sub> and R<sub>2</sub> are independently hydrogen, substituted or unsubstituted C<sub>1</sub>-C<sub>8</sub> alkyl, substituted or unsubstituted C<sub>3</sub>-C<sub>6</sub> cycloalkyl, substituted or unsubstituted C<sub>2</sub>-C<sub>8</sub> unsaturated alkyl, ketone, substituted or unsubstituted aryl, substituted or unsubstituted C<sub>1</sub>-C<sub>4</sub> alkoxy, substituted or unsubstituted arylhydroxy, substituted or unsubstituted amino, C<sub>1</sub>-C<sub>4</sub> lower ester, C<sub>1</sub>-C<sub>4</sub> lower thioester, thiol, substituted or unsubstituted carboxyl, epoxy, substituted or unsubstituted C<sub>1</sub>-C<sub>4</sub> lower thioalkoxy; or R<sub>1</sub> and R<sub>2</sub> are fused to form C<sub>3</sub>-C<sub>4</sub> saturated or unsaturated chain; R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>7</sub> are independently hydrogen, halogen, hydroxy, nitro, C<sub>1</sub>-C<sub>4</sub> lower ester, C<sub>1</sub>-C<sub>4</sub> lower alkyl, C<sub>1</sub>-C<sub>4</sub> lower thioalkyl, substituted or unsubstituted C<sub>3</sub>-C<sub>6</sub> cycloalkyl, C<sub>1</sub>-C<sub>4</sub> lower alkoxy, C<sub>1</sub>-C<sub>4</sub> lower thioalkoxy, substituted or unsubstituted aryl, substituted or unsubstituted lower arylalkoxy, substituted or unsubstituted lower alkylamino, or lower alkyl substituted or unsubstituted carbamate; or among R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>7</sub>, two adjacent groups are bonded with each other to form 1,2-phenylene or 2,3-naphthylene; X is oxygen, sulfur, or substituted or unsubstituted imino; Y is bonded at the 3-position or 4-position of the aromatic ring part wherein Y is oxygen or -NR<sub>8</sub>- (wherein, R<sub>8</sub> is the same with the above-mentioned R<sub>3</sub>); Z is hydroxy, C<sub>1</sub>-C<sub>4</sub> lower alkoxy, C<sub>1</sub>-C<sub>4</sub> lower thioalkoxy, substituted or unsubstituted aryloxy, C<sub>1</sub>-C<sub>4</sub> lower alkylamino, substituted or unsubstituted cycloamino containing 1-5 nitrogen atoms; A is nitrogen or -CH-; its pharmaceutically acceptable acid addition salts and process for the preparation thereof.



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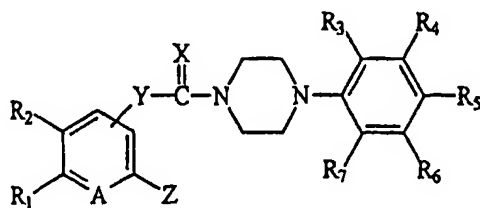
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## Piperazine derivatives and process for the preparation thereof

The present invention relates to new piperazine derivatives of the general formula (I)

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( I )

wherein R<sub>1</sub> and R<sub>2</sub> are independently hydrogen, substituted or  
 15 unsubstituted C<sub>1</sub>-C<sub>8</sub> alkyl, substituted or unsubstituted C<sub>3</sub>-C<sub>6</sub> cycloalkyl,  
 substituted or unsubstituted C<sub>2</sub>-C<sub>8</sub> unsaturated alkyl, ketone, substituted  
 or unsubstituted aryl, substituted or unsubstituted C<sub>1</sub>-C<sub>4</sub> alkoxy,  
 substituted or unsubstituted arylhydroxy, substituted or unsubstituted  
 amino, C<sub>1</sub>-C<sub>4</sub> lower ester, C<sub>1</sub>-C<sub>4</sub> lower thioester, thiol, substituted or  
 20 unsubstituted carboxyl, epoxy, substituted or unsubstituted C<sub>1</sub>-C<sub>4</sub> lower  
 thioalkoxy; or R<sub>1</sub> and R<sub>2</sub> are fused to form C<sub>3</sub>-C<sub>4</sub> saturated or  
 unsaturated chain; R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>7</sub> are independently hydrogen,  
 halogen, hydroxy, nitro, C<sub>1</sub>-C<sub>4</sub> lower ester, C<sub>1</sub>-C<sub>4</sub> lower alkyl, C<sub>1</sub>-C<sub>4</sub>  
 lower thioalkyl, substituted or unsubstituted C<sub>3</sub>-C<sub>6</sub> cycloalkyl, C<sub>1</sub>-C<sub>4</sub>  
 25 lower alkoxy, C<sub>1</sub>-C<sub>4</sub> lower thioalkoxy, substituted or unsubstituted aryl,  
 substituted or unsubstituted lower arylalkoxy, substituted or  
 unsubstituted lower alkylamino, or lower alkyl substituted or  
 unsubstituted carbamate; or among R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub> and R<sub>7</sub>, two adjacent  
 groups are bonded with each other to form 1,2-phenylene or  
 30 2,3-naphthylene; X is oxygen, sulfur, or substituted or unsubstituted  
 imino; Y is bonded at the 3-position or 4-position of the aromatic ring  
 part wherein Y is oxygen or -NR<sub>8</sub>- (wherein, R<sub>8</sub> is the same with the  
 above-mentioned R<sub>3</sub>); Z is hydroxy, C<sub>1</sub>-C<sub>4</sub> lower alkoxy, C<sub>1</sub>-C<sub>4</sub> lower  
 thioalkoxy, substituted or unsubstituted aryloxy, C<sub>1</sub>-C<sub>4</sub> lower alkylamino,  
 35 substituted or unsubstituted cycloamino containing 1-5 nitrogen atoms;  
 A is nitrogen or -CH=; its pharmaceutically acceptable acid addition

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salts and process for the preparation thereof.

In the above definitions, C<sub>1</sub>-C<sub>8</sub> alkyl means straight or branched alkyl group such as methyl, ethyl, propyl, isopropyl, n-butyl, isobutyl,

5 tert-butyl, pentyl, iso-pentyl, hexyl, heptyl, octyl, 2-methylpentyl or the like.

C<sub>1</sub>-C<sub>4</sub> lower alkyl means methyl, ethyl, propyl, iso-propyl, n-butyl, iso-butyl or tert-butyl.

Substituted or unsubstituted C<sub>3</sub>-C<sub>6</sub> cycloalkyl means substituted or  
10 unsubstituted cycloalkyl such as cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, substituted cyclopropyl, substituted cyclopentyl, substituted cyclohexyl or the like.

C<sub>1</sub>-C<sub>4</sub> lower ester means a carboxyl group esterified by a lower alkyl group.

15 C<sub>1</sub>-C<sub>4</sub> lower alkoxy means methoxy, ethoxy, propoxy, isopropoxy, butyloxy, isobutyloxy, tert-butyloxy group or the like.

C<sub>1</sub>-C<sub>4</sub> lower thioalkoxy means methylthio, ethylthio, propylthio,

isopropylthio, butylthio, isobutylthio, tert-butylthio group or the like.

C<sub>1</sub>-C<sub>4</sub> lower alkylamino means methylamino, ethylamino, propylamino,

20 butylamino group or the like.

Aryloxy means phenoxy, substituted phenoxy, naphthyloxy or substituted naphthyloxy or the like.

Cycloamino group containing 1-5 nitrogen atoms means pyrrolidinyl, pyrrolinyl, imidazolyl, imidazolidinyl, pyrazolyl, pyrazolinyl, pyrazolidinyl,

25 triazolyl, tetrazolyl, piperazinyl or the like.

The present inventors had studied for a long time to find compounds having intensive antitumor activity. As the results, now we have finally found out the facts that the present compounds of the general

30 formula(I) and acid addition salts thereof have not only prominent antitumor activities but very low toxicities.

Accordingly, the one object of the present invention is to provide the novel compounds of the general formula(I) and acid addition salts thereof having not only prominent antitumor activities but very low  
35 toxicities.

The other object of the present invention is to provide a process for



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the preparation of the compounds of general formula(I) and acid addition salts thereof.

The compounds of the present invention can be mixed with pharmaceutically acceptable vehicles by a known method to give pharmaceutical compositions and the pharmaceutical compositions can be used to prevent or treat with various kinds of tumors of human beings or mammals.

Therefore, another object of the present invention is to provide pharmaceutical compositions containing the compounds of the general formula(I) or acid addition salts thereof as active ingredients.

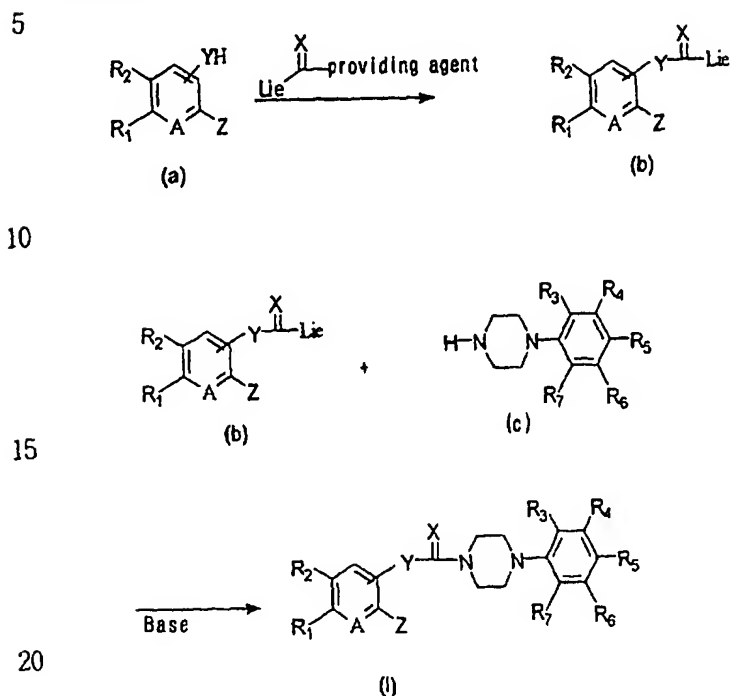
Acids which can be reacted with the compounds of the general formula(I) to form acid addition salts are pharmaceutically acceptable inorganic or organic acids; for example, inorganic acids such as hydrochloric acid, bromic acid, sulfuric acid, phosphoric acid, nitric acid; organic acids such as formic acid, acetic acid, propionic acid, succinic acid, citric acid, maleic acid, malonic acid, glycolic acid, lactic acid; amino acids such as glycine, alanine, valine, leucine, isoleucine, serine, cysteine, cystine, asparaginic acid, glutamic acid, lysine, arginine, tyrosine, proline; sulfonic acids such as methane sulfonic acid, ethane sulfonic acid, benzene sulfonic acid, toluene sulfonic acid; or the like.

Vehicles which can be used in the preparation of pharmaceutical compositions containing the compounds of the general formula(I) as active ingredients are sweetening agent, binding agent, dissolving agent, aids for dissolution, wetting agent, emulsifying agent, isotonic agent, adsorbent, degrading agent, antioxidant, antiseptics, lubricating agent, filler, perfume or the like; such as lactose, dextrose, sucrose, mannitol, sorbitol, cellulose, glycine, silica, talc, stearic acid, stearin, magnesium stearate, calcium stearate, magnesium aluminum silicate, starch, gelatine, tragacanth gum, glycine, silica, alginic acid, sodium alginate, methyl cellulose, sodium carboxy methyl cellulose, agar, water, ethanol, polyethylenglycol, polyvinyl pyrrolidone, sodium chloride, potassium chloride, orange essence, strawberry essence, vanilla aroma or the like.

Daily dosage of the compound of the general formula(I) may be varied depending on age, sex of patient and the degree of disease. Daily dosage is 1.0mg to 5,000mg may be administered one to several times.

The compounds of the general formula (I) according to the present invention may be prepared by the following scheme 1.

Scheme 1



wherein  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$ , A, X, Y and Z are as defined above, and Lie is a leaving group such as halogen atom, sulfonyl or the like.

The above process comprises reacting a compound of the general formula(a) with a  $-\text{C}(=\text{X})-$  group-providing agent in organic solvent to obtain a compound of the general formula(b) and successively reacting the compound of the general formula(b) with a compound of the general formula(c) to give the compound of the general formula(I). The used  $-\text{C}(=\text{X})-$ group-providing agent preferably be selected from 1,1-carbonyldiimidazole, 1,1-carbonylthiodiimidazole, phosgene, thiophosgene, carbonyldiphenoxide, phenylchloroformate or the like.

The reaction may be carried out in conventional organic solvent such as, for example, tetrahydrofuran, dichloromethane, chloroform,

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acetonitrile.

And also the reaction is preferably carried out in the presence of coupling agent such as conventional inorganic or organic base. Such conventional inorganic or organic base used in the reaction means

- 5 sodium hydride, potassium hydride, sodium hydroxide, potassium hydroxide, sodium carbonate, potassium carbonate, cesium carbonate, sodium bicarbonate, potassium bicarbonate, triethylamine, pyridine, DBU or the like, and 1-1.5 equivalent, preferably 1-1.1 equivalent thereof may be used.

- 10 The reaction may be carried out between 3°C and boiling point of the solvent used, preferably at 50°C-100°C for 5 - 48 hours, preferably for 10 - 24 hours.

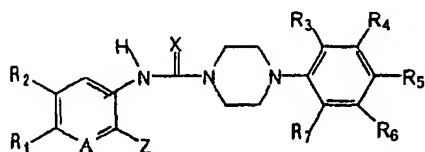
-C(=X)-group-providing agent may be used in an amount of 1 - 1.5 equivalent, preferably 1-1.1 equivalent to the starting compound.

15

A compound of the general formula(I) wherein Y is -NR<sub>6</sub>- may be prepared by the following scheme II

Scheme II.

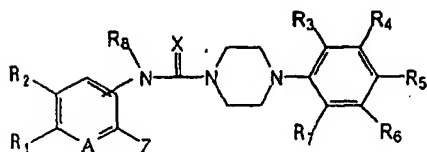
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(Ia)



R<sub>8</sub> providing agent



(Ib)

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wherein, R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, A, X and Z are as defined above.

A compound of the general formula(Ib) above may be prepared effectively by introducing R<sub>8</sub> providing agent into a compound of the  
5 general formula(Ia).

R<sub>8</sub> providing agent preferably used in the above reaction is C<sub>1</sub>-C<sub>8</sub> lower alkylhalogen, C<sub>1</sub>-C<sub>8</sub> lower alkyl sulfonate, substituted or unsubstituted C<sub>3</sub>-C<sub>8</sub> cycloalkylhalogen, arylhalogen, substituted or unsubstituted C<sub>3</sub>-C<sub>8</sub> cycloalkyl sulfonate, arylsulfonate, or the like.  
10

C<sub>1</sub>-C<sub>8</sub> lower alkylhalogen means methylchloride, methylbromide, methyliodide, ethylchloride, ethylbromide, ethyliodide, propylchloride, propylbromide, propyliodide, butylchloride, butylbromide, butyliodide,  
15 pentylchloride, pentylbromide, pentyliodide, ethylbromoacetate, or the like.

C<sub>1</sub>-C<sub>8</sub> lower alkyl sulfonate means methylsulfonate, ethylsulfonate, propylsulfonate, butylsulfonate, pentylsulfonate, or the like.

20 Substituted or unsubstituted C<sub>3</sub>-C<sub>8</sub> cycloalkylhalogen cyclopropylchloride, cyclopropylbromide, cyclopropyliodide, cyclobutylchloride, cyclobutylbromide, cyclobutyliodide, cyclopentylchloride, cyclopentylbromide, cyclopentyliodide, cyclohexylchloride, cyclohexylbromide, cyclohexyliodide, cyclopropyl methylchloride, cyclopropyl methylbromide, cyclopropyl methyliodide, cyclobutyl  
25 methylchloride, cyclobutyl methylbromide, cyclobutyl methyliodide, cyclopentyl methylchloride, cyclopentyl methylbromide, cyclopentyl methyliodide, cyclohexyl methylchloride, cyclohexyl methylbromide, cyclohexyl methyliodide, or the like.

30 Arylhalogen means benzylchloride, benzylbromide, benzyliodide, benzoylchloride, benzoylbromide, benzoyliodide, toluylchloride, toluylbromide, toluyliodide, or the like.

35 Substituted or unsubstituted C<sub>3</sub>-C<sub>8</sub> cycloalkyl sulfonate means cyclopropyl sulfonate, cyclobutyl sulfonate, cyclopentyl sulfonate,

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cyclohexyl sulfonate, methylcyclopropyl sulfonate, methylcyclobutyl sulfonate, methylcyclopentyl sulfonate, methylcyclohexyl sulfonate, or the like.

- 5 Arylsulfonate means benzyl sulfonate, benzoyl sulfonate, tolyl sulfonate, or the like.

More particularly, a compound of the general formula (1a) may be reacted with an alkylating agent or arylating agent in a solvent at the  
10 temperature of 25-80°C, for 30 minutes - 20 hours to give the object compound of the general formula(1b).

An alkylating agent or arylating agent may be used in amount of 1.0 - 1.5 equivalent.

Conventional organic solvent such as for example tetrahydrofuran,  
15 dichloromethane, acetonitrile, dimethylformamide may be used in the above reaction.

In the above reactions, if any acid material is formed, any basic material may be preferably added as scavenger in order to eliminate the  
20 acid material from the reaction phase. Such basic material may be alkali metal hydroxide, alkali earth metal hydroxide, alkali metal oxide, alkali earth metal oxide, alkali metal carbonate, alkali earth metal carbonate, alkali metal hydrogen carbonate, alkali earth metal hydrogen carbonate such as sodium hydroxide, potassium hydroxide, calcium  
25 hydroxide, magnesium hydroxide, magnesium oxide, calcium oxide, potassium carbonate, sodium carbonate, calcium carbonate, magnesium carbonate, magnesium bicarbonate, sodium bicarbonate, calcium bicarbonate or the like, or organic amines.

30 The compound of the general formula(a) is described in prior art ( J. Med. Chem., 1992; 35, 3784, 3792 ) or may be prepared in a similar method to the art.

35 Hereinafter the present invention will be described in more details with reference to following examples but it is not intended to limit the scope

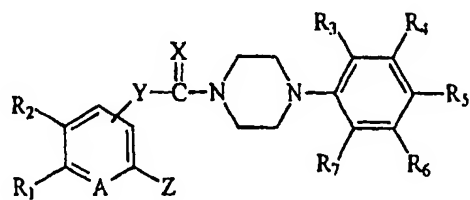
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of the invention thereinto.

Compounds of the general formula(I) and formula(Ib) are prepared in following examples according to the above-mentioned process.

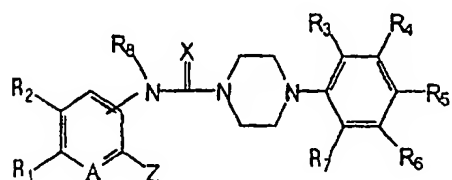
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(I)

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(Ib)



20 wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub>, A, X, Y, Z are the same above.

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
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










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Ex. No.	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	A	X	Y	Z	Y
1	Me	Me	SMe	H	H	H	H	N	O	NH	OMe	3-N
2	Me	Me		H	H	H	H	N	O	NH	OMe	3-N
3	Me	Me	Me	Me	H	Me	Me	N	O	NH	OMe	3-N
4	Me	Et	SMe	H	H	H	H	N	O	NH	OMe	3-N
5	Me	Et		H	H	H	H	N	O	NH	OMe	3-N
6	Me	Et	Me	Me	H	Me	Me	N	O	NH	OMe	3-N
7	Me	Et	H	SH	H	H	H	N	O	NH	OMe	3-N
8	Me	nPr	H	OMe	H	OMe	H	N	O	NH	OMe	3-N
9	Me	nPr	H	Me	H	Me	H	N	O	NH	OMe	3-N
10	Me	nPr	H	F	H	F	H	N	O	NH	OMe	3-N
11	Me	nPr	OMe	H	H	H	H	N	O	NH	OMe	3-N
12	Et	Me	H	OMe	H	OMe	H	N	O	NH	OMe	3-N
13	Et	Me	H	Me	H	Me	H	N	O	NH	OMe	3-N
14	Et	Me	H	OH	H	H	H	N	O	NH	OMe	3-N














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


Ex. No.	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	A	X	Y	Z	Y	
5	15	nPr	Me	H	OMe	H	OMe	H	N	O	NH	OMe	3-N
	16	nPr	Me	H	Me	H	Me	H	N	O	NH	OMe	3-N
	17	nPr	Me	H	OH	H	H	H	N	O	NH	OMe	3-N
	18	-(CH <sub>2</sub> ) <sub>3</sub> -		H	OMe	H	OMe	H	N	O	NH	OMe	3-N
10	19	-(CH <sub>2</sub> ) <sub>3</sub> -		H	Me	H	Me	H	N	O	NH	OMe	3-N
	20	-(CH <sub>2</sub> ) <sub>4</sub> -		H	OMe	H	OMe	H	N	O	NH	OMe	3-N
	21	-(CH <sub>2</sub> ) <sub>4</sub> -		H	Me	H	Me	H	N	O	NH	OMe	3-N
	22	Me	Me	H	Me	H	Me	H	N	S	NH	OMe	3-N
15	23	Me	Me	H	F	H	F	H	N	S	NH	OMe	3-N
	24	Me	Me	H	OH	H	H	H	N	S	NH	OMe	3-N
	25	Me	nPr	H	OMe	H	OMe	H	N	S	NH	OMe	3-N
	26	nPr	Me	H	OMe	H	OMe	H	N	S	NH	OMe	3-N
20	27	nPr	Me	H	Me	H	Me	H	N	S	NH	OMe	3-N
	28	nPr	Me	H	OH	H	H	H	N	S	NH	OMe	3-N
	29	-(CH <sub>2</sub> ) <sub>3</sub> -		H	OMe	H	OMe	H	N	S	NH	OMe	3-N
	30	-(CH <sub>2</sub> ) <sub>3</sub> -		H	Me	H	Me	H	N	S	NH	OMe	3-N
25	31	-(CH <sub>2</sub> ) <sub>4</sub> -		H	OMe	H	OMe	H	N	S	NH	OMe	3-N
	32	-(CH <sub>2</sub> ) <sub>4</sub> -		H	Me	H	Me	H	N	S	NH	OMe	3-N
	33	Me	Me	H	OMe	H	OMe	H	N	O	NH	NHMe	3-N
	34	Me	Me	H	Me	H	Me	H	N	O	NH	NHMe	3-N
30	35	Me	Et	H	Me	H	Me	H	N	O	NH	NHMe	3-N
	36	-(CH <sub>2</sub> ) <sub>3</sub> -		H	OMe	H	OMe	H	N	O	NH	NHMe	3-N
	37	-(CH <sub>2</sub> ) <sub>3</sub> -		H	Me	H	Me	H	N	O	NH	NHMe	3-N
	38	Me	Me	H	OMe	H	OMe	H	N	O	NH		3-N
35	39	Me	Me	H	Me	H	Me	H	N	O	NH		3-N





Ex. No.	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	A	X	Y	Z	Y
5	40	Me	Et	H	OMe	H	OMe	H	N	O	NH	 3-N
	41	Me	Et	H	Me	H	Me	H	N	O	NH	 3-N
	42	Me	Me	H	OMe	H	OMe	H	N	O	NH	 3-N
	43	Me	Me	H	Me	H	Me	H	N	O	NH	 3-N
	44	Me	Et	H	OMe	H	OMe	H	N	O	NH	 3-N
10	45	Me	Et	H	Me	H	Me	H	N	O	NH	 3-N
	46	Me	Ac	H	OMe	H	OMe	H	N	O	NH	OMe 3-N
	47	Me	Ac	H	Me	H	Me	H	N	O	NH	OMe 3-N
	48	Me	Ac	H	F	H	F	H	N	O	NH	OMe 3-N
	49	Me	Ac	H	Cl	H	Cl	H	N	O	NH	OMe 3-N
15	50	Me	Ac	Me	Me	H	H	H	N	O	NH	OMe 3-N
	51	Me	Ac	OMe	H	H	H	H	N	O	NH	OMe 3-N
	52	Me	Ac	H	OH	H	H	H	N	O	NH	OMe 3-N
	53	Me	Ac	H	OMe	H	OMe	H	N	S	NH	OMe 3-N
	54	Me	Ac	H	Me	H	Me	H	N	S	NH	OMe 3-N
20	55	Me	Ac	H	OH	H	H	H	N	S	NH	OMe 3-N
	56	Me		H	OMe	H	OMe	H	N	O	NH	OMe 3-N
	57	Me		H	Me	H	Me	H	N	O	NH	OMe 3-N
	58	Me		Me	Me	H	H	H	N	O	NH	OMe 3-N
	59	Me		H	F	H	F	H	N	O	NH	OMe 3-N
30	60	Me		H	Cl	H	Cl	H	N	O	NH	OMe 3-N
	61	Me		OMe	H	H	H	H	N	O	NH	OMe 3-N
	62	Me		H	OH	H	H	H	N	O	NH	OMe 3-N
	63	Me		H	OMe	H	OMe	H	N	S	NH	OMe 3-N
	64	Me		H	Me	H	Me	H	N	S	NH	OMe 3-N


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Ex. No.	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	A	X	Y	Z	Y
5	65	Me		H	OMe	H	OMe	H	N	O	NH	OMe 3-N
	66	Me		H	Me	H	Me	H	N	O	NH	OMe 3-N
	67	Me		H	OMe	H	OMe	H	N	O	NH	OMe 3-N
	68	Me		H	Me	H	Me	H	N	O	NH	OMe 3-N
10	69	Me		H	OMe	H	OMe	H	N	O	NH	OMe 3-N
	70	Me		H	Me	H	Me	H	N	O	NH	OMe 3-N
	71	Me		H	OMe	H	OMe	H	N	O	NH	OMe 3-N
15	72	Me		H	Me	H	Me	H	N	O	NH	OMe 3-N
	73	Me	Vinyl	H	OMe	H	OMe	H	N	O	NH	OMe 3-N
	74	Me	Vinyl	H	Me	H	Me	H	N	O	NH	OMe 3-N
	75	Me	Vinyl	H	F	H	F	H	N	O	NH	OMe 3-N
20	76	Me		H	OMe	H	OMe	H	N	O	NH	OMe 3-N
	77	Me		H	Me	H	Me	H	N	O	NH	OMe 3-N
25	78	Me		H	OMe	H	OMe	H	N	O	NH	OMe 3-N
	79	Me		H	OMe	H	OMe	H	N	O	NH	OMe 3-N
	80	Me		H	Me	H	Me	H	N	O	NH	OMe 3-N
30												

Ex. No.	R <sub>1</sub> and R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>	A	X	Z	Y	
5	81	-CH=CH-CH=CH-	H	OMe	H	OMe	H	H	N	O	OMe	3-N
	82	-CH=CH-CH=CH-	H	Me	H	Me	H	H	N	O	OMe	3-N
	83	-CH=CH-CH=CH-	Me	Me	H	H	H	H	N	O	OMe	3-N
	84	-CH=CH-CH=CH-	H	F	H	F	H	H	N	O	OMe	3-N
	85	-CH=CH-CH=CH-	H	Cl	H	Cl	H	H	N	O	OMe	3-N
10	86	-CH=CH-CH=CH-	F	H	H	H	H	H	N	O	OMe	3-N
	87	-CH=CH-CH=CH-	Cl	H	H	H	H	H	N	O	OMe	3-N
	88	-CH=CH-CH=CH-	H	Cl	H	H	H	H	N	O	OMe	3-N
	89	-CH=CH-CH=CH-	H	OH	H	H	H	H	N	O	OMe	3-N
15	90	-CH=CH-CH=CH-	OMe	H	H	H	H	H	N	O	OMe	3-N
	91	-CH=CH-CH=CH-	SMe	H	H	H	H	H	N	O	OMe	3-N
	92	-CH=CH-CH=CH-	H		H	H	H	H	N	O	OMe	3-N
20	93	-CH=CH-CH=CH-	H		H	H	H	H	N	O	OMe	3-N
	94	-CH=CH-CH=CH-	OMe	H	H	Me	H	H	N	O	OMe	3-N
	95	-CH=CH-CH=CH-	OMe	H	H	Ph	H	H	N	O	OMe	3-N
	96	-CH=CH-CH=CH-	Me	H	H	OMe	H	H	N	O	OMe	3-N
25	97	-CH=CH-CH=CH-	-Benzo-		H	H	H	H	N	O	OMe	3-N
	98	-CH=CH-CH=CH-	H	OMe	H	OMe	H	Me	N	O	OMe	3-N
	99	-CH=CH-CH=CH-	H	OMe	H	OMe	H	Et	N	O	OMe	3-N
	100	-CH=CH-CH=CH-	H	OMe	H	OMe	H	iPr	N	O	OMe	3-N
30	101	-CH=CH-CH=CH-	H	OMe	H	OMe	H		N	O	OMe	3-N
	102	-CH=CH-CH=CH-	H	OMe	H	OMe	H	Benzyl	N	O	OMe	3-N
	103	-CH=CH-CH=CH-	H	Me	H	Me	H	Me	N	O	OMe	3-N
35	104	-CH=CH-CH=CH-	H	Me	H	Me	H	Et	N	O	OMe	3-N
	105	-CH=CH-CH=CH-	H	Me	H	Me	H	iPr	N	O	OMe	3-N

Ex. No	R <sub>1</sub> and R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>	A	X	Z	Y	
5	106	-CH=CH-CH=CH-	H	Me	H	Me	H	Benzyl	N	O	OMe	3-N
	107	-CH=CH-CH=CH-	H		H	H	H	Me	N	O	OMe	3-N
	108	-CH=CH-CH=CH-	H		H	H	H	Et	N	O	OMe	3-N
	109	-CH=CH-CH=CH-	H	OMe	H	OMe	H	H	N	S	OMe	3-N
10	110	-CH=CH-CH=CH-	H	Me	H	Me	H	H	N	S	OMe	3-N
	111	-CH=CH-CH=CH-	H	F	H	F	H	H	N	S	OMe	3-N
	112	-CH=CH-CH=CH-	H	Cl	H	Cl	H	H	N	S	OMe	3-N
	113	-CH=CH-CH=CH-	H	OMe	H	H	H	H	N	S	OMe	3-N
15	114	-CH=CH-CH=CH-	H	OMe	H	OMe	H	H	N	O	Me	3-N
	115	-CH=CH-CH=CH-	H	Me	H	Me	H	H	N	O	Me	3-N
	116	-CH=CH-CH=CH-	Me	Me	H	H	H	H	N	O	Me	3-N
	117	-CH=CH-CH=CH-	H	F	H	F	H	H	N	O	Me	3-N
20	118	-CH=CH-CH=CH-	H	Cl	H	Cl	H	H	N	O	Me	3-N
	119	-CH=CH-CH=CH-	OMe	H	H	H	H	H	N	O	Me	3-N
	120	-CH=CH-CH=CH-	F	H	H	H	H	H	N	O	Me	3-N
	121	-CH=CH-CH=CH-	Cl	H	H	H	H	H	N	O	Me	3-N
25	122	-CH=CH-CH=CH-	SMe	H	H	H	H	H	N	O	Me	3-N
	123	-CH=CH-CH=CH-	OMe	H	H	Me	H	H	N	O	Me	3-N
	124	-CH=CH-CH=CH-	-Benzo-		H	H	H	H	N	O	Me	3-N
	125	-CH=CH-CH=CH-	H	OMe	H	OMe	H	H	N	S	Me	3-N
30	126	-CH=CH-CH=CH-	H	Me	H	Me	H	H	N	S	Me	3-N
	127	-CH=CH-CH=CH-	H	F	H	F	H	H	N	S	Me	3-N
	128	-CH=CH-CH=CH-	H	OMe	H	OMe	H	H	N	O	2-Py	4-N
	129	-CH=CH-CH=CH-	H	OMe	H	OMe	H	H	N	O	3-Py	4-N
35	130	-CH=CH-CH=CH-	H	OMe	H	OMe	H	H	N	O	2-Thienyl	4-N
	131	-CH=CH-CH=CH-	H	Me	H	Me	H	H	N	O	3-Py	4-N




















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
	Ex. No.	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>	A	X	Z	Y
5	132	Me	Me	H	OMe	H	OMe	H	Me	N	O	OMe	3-N
	133	Me	Me	H	OMe	H	OMe	H	Et	N	O	OMe	3-N
	134	Me	Me	H	OMe	H	OMe	H	i-Pr	N	O	OMe	3-N
	135	Me	Me	H	Me	H	Me	H	Me	N	O	OMe	3-N
	136	Me	Me	OMe	H	H	H	H	Me	N	O	OMe	3-N
10	137	Me	Me	OMe	H	H	H	H	Et	N	O	OMe	3-N
	138	Me	Me	OMe	H	H	H	H	Bn	N	O	OMe	3-N
	139	Me	Me	OMe	H	H	H	H		N	O	OMe	3-N
	140	Me	Me	Me	H	H	OMe	H	Me	N	O	OMe	3-N
15	141	Me	Me	Me	H	H	OMe	H	Et	N	O	OMe	3-N
	142	Me	Me	Me	H	H	OMe	H	Bn	N	O	OMe	3-N
	143	Me	Et	H	OMe	H	OMe	H	Me	N	O	OMe	3-N
	144	Me	Et	H	Me	H	Me	H	Me	N	O	OMe	3-N
20	145	Me	Et	H	Me	H	Me	H	Et	N	O	OMe	3-N





25

30



35

Ex. No.	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>	A	X	Z	Y
5	146	Me	nPr	H	OMe	H	OMe	H	Me	N	O	OMe 3-N
	147	Et	Me	H	OMe	H	OMe	H	Me	N	O	OMe 3-N
	148	nPr	Me	H	OMe	H	OMe	H	Me	N	O	OMe 3-N
	149	Me	Ac	H	OMe	H	OMe	H	Me	N	O	OMe 3-N
10	150	Me	Ac	H	OMe	H	OMe	H	Et	N	O	OMe 3-N
	151	Me	Ac	H	Me	H	Me	H	Me	N	O	OMe 3-N
	152	Me		H	OMe	H	OMe	H	Me	N	O	OMe 3-N
	153	Me		H	OMe	H	OMe	H	Et	N	O	OMe 3-N
15	154	Me		H	Me	H	Me	H	Me	N	O	OMe 3-N
	155	Me		H	OMe	H	OMe	H	Me	N	O	OMe 3-N
	156	Me		H	Me	H	Me	H	Me	N	O	OMe 3-N
	157	Me		H	OMe	H	OMe	H	Me	N	O	OMe 3-N
20	158	Me	Vinyl	H	OMe	H	OMe	H	Me	N	O	OMe 3-N
	159	Me	Vinyl	H	Me	H	Me	H	Me	N	O	OMe 3-N
	160	Me	Vinyl	H	OMe	H	OMe	H	Et	N	O	OMe 3-N
	161	Me		H	OMe	H	OMe	H	Me	N	O	OMe 3-N
25	162	Me		H	Me	H	Me	H	Me	N	O	OMe 3-N
	163	Me	Ac	H	OMe	H	OMe	H		N	O	OMe 3-N
	164	Me	Ac	H	Me	H	Me	H		N	O	OMe 3-N
	165	Me	Ac	H	OMe	H	OMe	H		N	O	OMe 3-N
30	166	Me		H	OMe	H	OMe	H		N	O	OMe 3-N
	167	Me		H	OMe	H	OMe	H		N	O	OMe 3-N
	168	Me		H	Me	H	Me	H		N	O	OMe 3-N
	169	Me		H	Me	H	Me	H		N	O	OMe 3-N

	Ex. No.	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>	A	X	Z	Y
5	170	Me	Me	H	H	H	H	H	H	CH	O	OMe	3-N
	171	Me	Me	H	OMe	H	OMe	H	H	CH	O	OMe	3-N
	172	Me	Me	H	Me	H	Me	H	H	CH	O	OMe	3-N
	173	Me	Me	Me	Me	H	H	H	H	CH	O	OMe	3-N
	174	Me	Me	Me	Me	H	Me	Me	H	CH	O	OMe	3-N
10	175	Me	Me	H	F	H	F	H	H	CH	O	OMe	3-N
	176	Me	Me	Cl	H	H	H	H	H	CH	O	OMe	3-N
	177	Me	Me	H	Cl	H	H	H	H	CH	O	OMe	3-N
	178	Me	Me	OH	H	H	H	H	H	CH	O	OMe	3-N
	179	Me	Me	H	OH	H	H	H	H	CH	O	OMe	3-N
15	180	Me	Me	H	SH	H	H	H	H	CH	O	OMe	3-N
	181	Me	Me	OAc	H	H	H	H	H	CH	O	OMe	3-N
	182	Me	Me	H	OAc	H	H	H	H	CH	O	OMe	3-N
	183	Me	Me	OMe	H	H	H	H	H	CH	O	OMe	3-N
	184	Me	Me	H	Me	H	H	OMe	H	CH	O	OMe	3-N
20	185	Me	Me	H	OMe	H	H	Me	H	CH	O	OMe	3-N
	186	Me	Me	H	OMe	H	H	Ph	H	CH	O	OMe	3-N
	187	Me	Me		H	H	H	H	H	CH	O	OMe	3-N
	188	Me	Me	Benzo		H	H	H	H	CH	O	OMe	3-N
	189	Me	Me	Naphto		H	H	H	H	CH	O	OMe	3-N
25	190	Me	Me	H	OMe	H	OMe	H	Me	CH	O	OMe	3-N
	191	Me	Me	H	Me	H	Me	H	Me	CH	O	OMe	3-N
	192	Me	Me	H	F	H	F	H	Me	CH	O	OMe	3-N
	193	Me	Me	H	OMe	H	OMe	H	Et	CH	O	OMe	3-N
	194	Me	Me	H	Me	H	Me	H	Et	CH	O	OMe	3-N

Ex. No.	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>	A	X	Z	Y	
5	195	Me	Me	H	F	H	F	H	Et	CH	O	OMe	3-N
	196	Me	Me	H	F	H	F	H	iPr	CH	O	OMe	3-N
	197	Me	Me	H	OMe	H	OMe	H	H	CH	S	OMe	3-N
	198	Me	Me	H	Me	H	Me	H	H	CH	S	OMe	3-N
	199	Me	Me	Me	Me	H	H	H	H	CH	S	OMe	3-N
10	200	Me	Me	H	F	H	F	H	H	CH	S	OMe	3-N
	201	Me	Me	H	Cl	H	Cl	H	H	CH	S	OMe	3-N
	202	Me	Me	F	H	H	H	H	H	CH	S	OMe	3-N
	203	Me	Me	Cl	H	H	H	H	H	CH	S	OMe	3-N
	204	Me	Me	OMe	H	H	H	H	H	CH	S	OMe	3-N
15	205	Me	Me	SMe	H	H	H	H	H	CH	S	OMe	3-N
	206	Me	Me	H	OH	H	H	H	H	CH	S	OMe	3-N
	207	Me	Me	OPh	H	H	H	H	H	CH	S	OMe	3-N
	208	Me	Me		H	H	H	H	H	CH	S	OMe	3-N
	209	Me	Me	H	OMe	H	H	Me	H	CH	S	OMe	3-N
20	210	Me	Me	Benzo		H	H	H	H	CH	S	OMe	3-N
	211	Me	Acetyl	H	OMe	H	OMe	H	H	CH	O	OMe	3-N
	212	Me	Acetyl	H	Me	H	Me	H	H	CH	O	OMe	3-N
	213	Me	Acetyl	H	Cl	H	Cl	H	H	CH	O	OMe	3-N
	214	Me		H	OMe	H	OMe	H	H	CH	O	OMe	3-N
25	215	Me		H	Me	H	Me	H	H	CH	O	OMe	3-N
	216	Me	Vinyl	H	OMe	H	OMe	H	H	CH	O	OMe	3-N
	217	Me	Vinyl	H	Me	H	Me	H	H	CH	O	OMe	3-N
	218	Me	Acetyl	H	OMe	H	OMe	H	H	CH	S	OMe	3-N
	219	Me	Acetyl	H	Me	H	Me	H	H	CH	S	OMe	3-N
30	220	Me	Acetyl	H	Cl	H	Cl	H	H	CH	S	OMe	3-N
	221	Me		H	OMe	H	OMe	H	H	CH	S	OMe	3-N



Ex. No.	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>	A	X	Z	Y
222	Me		H	Me	H	Me	H	H	CH	S	OMe	3-N
223	Me		H	Cl	H	Cl	H	H	CH	S	OMe	3-N
224	Me	Me	H	OMe	H	OMe	H	$\text{CH}_2\overset{\text{O}}{\underset{\text{O}}{\parallel}}\text{OEt}$	CH	O	OMe	3-N
225	Me	Me	H	Me	H	Me	H	$\text{CH}_2\overset{\text{O}}{\underset{\text{O}}{\parallel}}\text{OEt}$	CH	O	OMe	3-N
226	Me	Me	H	OMe	H	OMe	H	$\text{CH}_2\overset{\text{O}}{\underset{\text{O}}{\parallel}}\text{OH}$	CH	O	OMe	3-N
227	Me	Me	H	Me	H	Me	H	$\text{CH}_2\overset{\text{O}}{\underset{\text{O}}{\parallel}}\text{OH}$	CH	O	OMe	3-N
228	Me	Me	H	OMe	H	OMe	H	H	CH	O	OH	3-N
229	Me	Me	H	Me	H	Me	H	H	CH	O	OH	3-N
230	Me	Me	H	F	H	F	H	H	CH	O	OH	3-N
231	Me	Me	H	Cl	H	Cl	H	H	CH	O	OH	3-N

- 20 -

## Example 1

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-methylthio phenyl)piperazine:

- 5 a) Phenyl N-(5,6-dimethyl-2-methoxypyridin-3-yl)carbamate:  
3-Amino-5,6-dimethyl-2-methoxypyridine(1.52g, 0.01mol) and  
phenylchloroformate(1.56g, 0.01mol) were dissolved in dichloromethane  
and was stirred at room temperature for 2 hours. The mixture was  
concentrated under the reduced pressure to remove the solvent. The  
10 concentrate was purified by column chromatography(ethylacetate :  
hexane = 1:6) to obtain the titled compound.  
yield: 92 %  
 $^1\text{H-NMR}(\text{CDCl}_3)$   $\delta$  : 2.18(3H,s), 2.36(3H,s), 4.00(3H,s), 7.31(5H,m),  
8.07(1H,s)
- 15 b) 1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-methyl  
thiophenyl)piperazine:  
Phenyl N-(5,6-dimethyl-2-methoxypyridin-3-yl)carbamate(136mg,  
0.5mmol) and 1-(2-methylthiophenyl)piperazine(104mg, 0.5mmol) were  
20 dissolved in anhydrous tetrahydrofuran and DBU(76mg, 0.5mmol) was  
added. The mixture was stirred at room temperature for 2 hours and  
concentrated under the reduced pressure to remove tetrahydrofuran. The  
concentrate was purified by column chromatography(ethylacetate :  
hexane = 1 : 2) to obtain the titled compound.  
25 yield : 59%  
m.p. : 167-169°C  
 $^1\text{H NMR}(\text{CDCl}_3)$   $\delta$  : 2.21(3H,s), 2.43(6H,s), 3.06(4H,t), 3.68(4H,t),  
4.09(3H,s), 6.89(1H,s), 7.06(1H,m), 7.14(3H,s), 8.26(1H,s)

## 30 Example 2

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-isopropenyl phenyl)piperazine :

- Phenyl N-(5,6-dimethyl-2-methoxypyridin-3-yl)carbamate and  
1-(2-isopropenylphenyl)piperazine were reacted by the same way with  
35 the example 1 to obtain the titled compound.  
yield: 62 %

m.p. : 139-140°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.20(3H,s), 2.21(6H,s), 3.10(4H,t), 3.64(4H,t),  
3.84(3H,s), 5.07(1H,s), 5.13(1H,s), 6.64(1H,s), 6.98(1H,s), 7.04(3H,dd),  
7.18(1H,d), 7.91(1H,s)

5

Example 3

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2,3,5,6-tetramethylphenyl)piperazine:

Phenyl N-(5,6-dimethyl-2-methoxypyridin-3-yl)carbamate and

10 1-(2,3,5,6-tetramethylphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 71%

m.p. : 190-192°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.21(15H,s), 2.42(3H,s), 3.17(4H,t), 3.61(4H,t),

15 4.08(3H,s), 6.84(1H,s), 6.89(1H,s), 8.26(1H,s)

Example 4

1-[(5-Ethyl-6-methyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-methylthiophenyl)piperazine:

20 Phenyl N-(5-ethyl-6-methyl-2-methoxypyridin-3-yl)carbamate and 1-(2-methylthiophenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 56%

m.p. : 160-161°C

25 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.19(3H,t), 2.43(3H,s), 2.50(3H,s), 2.58(2H,q),  
3.07(4H,t), 3.69(4H,t), 4.15(3H,s), 6.93(1H,s), 7.06(1H,m), 7.14(3H,m),  
8.35(1H,s)

Mass(EI) m/z : Calcd for C<sub>21</sub>H<sub>28</sub>N<sub>4</sub>O<sub>2</sub> 400.1932, found 400.1925

30 Example 5

1-[(5-Ethyl-6-methyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-isopropenylphenyl)piperazine:

Phenyl N-(5-ethyl-6-methyl-2-methoxypyridin-3-yl)carbamate and

35 1-(2-isopropenylphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 51%

- 22 -

m.p. : 185-187°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.18(3H,t), 2.21(3H,s), 2.42(3H,s), 2.56(2H,q),  
3.08(4H,t), 3.62(4H,t), 4.03(3H,s), 5.08(1H,s), 5.13(1H,s), 6.90(1H,s),  
7.02(3H,m), 7.18(1H,d), 8.25(1H,s)

5

## Example 6

1-[(5-Ethyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(2,3,5,6-tetramethylphenyl)piperazine:

Phenyl N-(5-ethyl-2-methoxy-6-methylpyridin-3-yl)carbamate and

- 10 1-(2,3,5,6-tetramethylphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 69%

m.p. : 176-177°C

- <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.19(3H,t), 2.21(12H,s), 2.44(3H,s), 2.57(2H,q),  
15 3.17(4H,t), 3.62(4H,t), 4.06(3H,s), 6.84(1H,s), 6.92(1H,s), 8.30(1H,s)

## Example 7

1-[(5-Ethyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3-thiophenyl)piperazine:

- 20 Phenyl N-(5-ethyl-2-methoxy-6-methylpyridin-3-yl)carbamate and 1-(3-thiophenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 63%

m.p. : 108-110°C

- <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.17(3H,t), 2.37(3H,s), 2.49(2H,q), 3.28(4H,t),  
25 3.60(4H,t), 3.98(3H,s), 6.87(4H,m), 6.98(1H,s), 8.18(1H,s)

## Example 8

- 1-[(2-Methoxy-6-methyl-5-propylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

Phenyl N-(2-methoxy-6-methyl-5-propylpyridin-3-yl)carbamate and

- 30 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 67%

- 35 m.p. : 82-84°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 0.94(3H,t), 1.58(2H,m), 2.37(3H,s), 2.49(2H,q),

- 23 -

3.25(4H,t), 3.66(4H,t), 3.78(6H,s), 3.99(3H,s), 6.07(3H,m), 6.88(1H,s),  
8.16(1H,s)

Mass(EI) m/z : Calcd for  $C_{23}H_{32}N_4O_1$  428.2423, found 428.2447

5 Example 9

1-[(2-Methoxy-6-methyl-5-propylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine

Phenyl N-(2-methoxy-6-methyl-5-propylpyridin-3-yl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with

10 the example 1 to obtain the titled compound.

yield : 64%

m.p. : 145-146°C

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 0.95(3H,t), 1.59(2H,m), 2.29(6H,s), 2.41(3H,s),  
2.49(2H,q), 3.24(4H,t), 3.67(4H,t), 3.98(3H,s), 6.59(3H,m), 6.89(1H,s),

15 8.17(1H,s)

Mass(EI) m/z : Calcd for  $C_{23}H_{32}N_4O_4$  428.2423, found 428.2385

Example 10

1-[(2-Methoxy-6-methyl-5-propylpyridin-3-yl)aminocarbonyl]-4-(3,5-difluorophenyl)piperazine:

Phenyl N-(2-methoxy-6-methyl-5-propylpyridin-3-yl)carbamate and 1-(3,5-difluorophenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 57%

25 m.p. : 121-123°C

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 0.95(3H,t), 1.59(2H,m), 2.38(3H,s), 2.50(2H,q),  
3.29(3H,t), 3.66(3H,t), 4.00(3H,s), 6.28(1H,m), 6.36(2H,d), 6.87(1H,s),  
8.17(1H,s)

30 Example 11

1-[(2-Methoxy-6-methyl-5-propylpyridin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)piperazine:

Phenyl N-(2-methoxy-6-methyl-5-propylpyridin-3-yl)carbamate and 1-(2-methoxyphenyl)piperazine were reacted by the same way with the

35 example 1 to obtain the titled compound.

yield : 71%

- 24 -

m.p. : 109-110°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 0.95(3H,t), 1.59(2H,m), 2.37(3H,s), 2.49(2H,q),  
3.12(4H,t), 3.70(4H,t), 3.89(3H,s), 3.97(3H,s), 6.91(4H,m), 6.95(1H,s),  
5 8.19(1H,s)

## Example 12

1-[(6-Ethyl-2-methoxy-5-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

10 Phenyl N-(6-ethyl-2-methoxy-5-methylpyridin-3-yl)carbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 65%

m.p. : 115-116°C

15 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.21(3H,t), 2.21(3H,s), 2.65(2H,q), 3.27(4H,t),  
3.64(4H,t), 3.79(6H,s), 3.98(3H,s), 6.09(3H,m), 6.86(1H,s), 8.12(1H,s)  
Mass(EI) m/z : Calcd for C<sub>22</sub>H<sub>30</sub>N<sub>4</sub>O<sub>4</sub> 414.2267, found 414.2240

## Example 13

20 1-[(6-Ethyl-2-methoxy-5-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(6-ethyl-2-methoxy-5-methylpyridin-3-yl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

25 yield : 61%

m.p. : 135-136°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.22(3H,t), 2.21(3H,s), 2.29(6H,s), 2.65(2H,q),  
3.24(4H,t), 3.66(4H,t), 3.98(3H,s), 6.59(3H,m), 6.87(1H,s), 8.12(1H,s)  
Mass(EI) m/z : Calcd for C<sub>22</sub>H<sub>30</sub>N<sub>4</sub>O<sub>2</sub> 382.2368, found 382.2376

30

## Example 14

1-[(6-Ethyl-2-methoxy-5-methylpyridin-3-yl)aminocarbonyl]-4-(3-hydroxyphenyl)piperazine:

Phenyl N-(6-ethyl-2-methoxy-5-methylpyridin-3-yl)carbamate and

35 1-(3-hydroxyphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 56%

m.p. : 168-170°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.21(3H,t), 2.20(2H,s), 2.63(2H,t), 3.28(4H,t), 3.68(4H,t),  
3.98(3H,s), 6.41(1H,d), 6.55(1H,d), 6.84(1H,m), 6.87(1H,s), 7.13(1H,t),

5 8.10(1H,s)

Mass(EI) m/z : Calcd for C<sub>20</sub>H<sub>26</sub>N<sub>4</sub>O<sub>3</sub> 370.2004, found 370.1992

#### Example 15

10 1-[(2-Methoxy-5-methyl-6-propylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

Phenyl N-(2-methoxy-5-methyl-6-propylpyridin-3-yl)carbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 57%

15 m.p : 121-122°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 0.96(3H,t), 1.67(2H,m), 2.21(3H,s), 2.58(2H,t),  
3.26(4H,t), 3.68(4H,t), 3.79(6H,s), 3.97(3H,s), 6.14(3H,m), 6.89(1H,s),  
8.11(1H,s)

Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>32</sub>N<sub>4</sub>O<sub>4</sub> 428.2423, found 428.2423

20

#### Example 16

1-[(2-Methoxy-5-methyl-6-propylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

25 Phenyl N-(2-methoxy-5-methyl-6-propylpyridin-3-yl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 54%

m.p. : 138-139°C

30 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 0.96(3H,t), 1.72(2H,m), 2.21(6H,s), 2.30(3H,s),  
2.59(2H,t), 3.28(4H,t), 3.76(4H,t), 3.97(3H,s), 6.70(3H,m), 6.87(1H,s),  
8.11(1H,s)

Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>32</sub>N<sub>4</sub>O<sub>2</sub> 396.2525, found 396.2432

#### Example 17

35 1-[(2-Methoxy-5-methyl-6-propylpyridin-3-yl)aminocarbonyl]-4-(3-hydroxyphenyl)piperazine:

- 26 -

Phenyl N-(2-methoxy-5-methyl-6-propylpyridin-3-yl)carbamate and 1-(3-hydroxyphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 52%

5 m.p. : 153-155°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 0.95(3H,t), 1.69(2H,m), 2.19(3H,s), 2.59(2H,t), 3.22(4H,t), 3.68(4H,t), 3.97(3H,s), 6.42(1H,d), 6.52(1H,d), 6.87(1H,s), 7.12(1H,t), 8.09(1H,s)

Mass(EI) m/z : Calcd for C<sub>21</sub>H<sub>28</sub>N<sub>4</sub>O<sub>3</sub> 384.2161, found 384.2153

10

#### Example 18

1-[N-(2-Methoxy-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

Phenyl N-(2-methoxy-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl)

15 carbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 59%

m.p. : 143-144°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.10(2H,m), 2.87(4H,m), 3.12(4H,t), 3.70(4H,t),

20 3.78(6H,s), 4.00(3H,s), 6.08(3H,m), 6.90(1H,s), 8.24(1H,s)

#### Example 19

1-[N-(2-Methoxy-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

25 Phenyl N-(2-methoxy-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl)

carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 55%

m.p. : 183-185°C

30 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.08(2H,m), 2.28(6H,s), 2.87(4H,m), 3.22(4H,t), 3.67(4H,t), 4.00(3H,s), 6.57(3H,m), 6.89(1H,s), 8.24(1H,s)

#### Example 20

1-[(2-Methoxy-5,6,7,8-tetrahydroquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

35

Phenyl N-(2-methoxy-5,6,7,8-tetrahydroquinoline-3-yl)carbamate and



- 27 -

1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 54%

m.p. : 161-163°C

- 5 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.75(2H,m), 1.84(2H,m), 2.67(2H,t), 2.73(2H,t), 3.27(4H,t), 3.71(4H,t), 3.79(6H,s), 3.97(3H,s), 6.10(3H,m), 6.90(1H,s), 8.07(1H,s)

#### Example 21

- 10 1-[(2-Methoxy-5,6,7,8-tetrahydroquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(2-methoxy-5,6,7,8-tetrahydroquinolin-3-yl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

- 15 yield : 51%

m.p. : 143-144°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.75(2H,m), 1.84(2H,m), 2.30(6H,s), 2.68(2H,t), 2.72(2H,t), 3.26(4H,t), 3.67(4H,t), 3.97(3H,s), 6.61(3H,m), 6.91(1H,s), 8.07(1H,s)

20

#### Example 22

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminothiocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(5,6-dimethyl-2-methoxypyridin-3-yl)thiocarbamate(200mg,

- 25 0.7mmol) and 1-(3,5-dimethylphenyl)piperazine(154mg, 0.7mmol) were dissolved in anhydrous tetrahydrofuran and DBU(106mg) was added thereto. The mixture was stirred at room temperature for 2 hours and concentrated under the reduced pressure to remove the solvent. The concentrate was purified by column chromatography( ethylacetate :

- 30 hexane = 1 : 2 ) to obtain the titled compound.

yield : 50%

m.p. : 192-193°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.21(3H,s), 2.29(6H,s), 2.36(3H,s), 3.33(4H,t), 3.96(3H,s), 4.09(4H,t), 6.57(3H,m), 7.33(1H,s), 8.11(1H,s)

- 35 Mass(EI) m/z : Calcd for C<sub>21</sub>H<sub>28</sub>N<sub>4</sub>O<sub>1</sub>S<sub>1</sub> 384.1983, found 384.1992

- 28 -

## Example 23

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminothiocarbonyl]-4-(3,5-difluorophenyl)piperazine:

Phenyl N-(5,6-dimethyl-2-methoxypyridin-3-yl)thiocarbamate and

- 5 1-(3,5-difluorophenyl)piperazine were reacted by the same way with the example 22 to obtain the titled compound.

yield : 47%

m.p. : 60-62°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.21(3H,s), 2.36(3H,s), 3.39(4H,t), 3.96(3H,s),

- 10 4.10(3H,t), 6.29(3H,m), 7.33(1H,s), 8.14(1H,s)

## Example 24

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminothiocarbonyl]-4-(3-hydroxyphenyl)piperazine:

- 15 Phenyl N-(5,6-dimethyl-2-methoxypyridin-3-yl)thiocarbamate and 1-(3-hydroxyphenyl)piperazine were reacted by the same way with the example 22 to obtain the titled compound.

yield : 43%

m.p. : 185-186°C

- 20 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.14(3H,s), 2.36(3H,s), 3.25(4H,t), 3.89(3H,s), 4.09(4H,t), 6.30(1H,d), 6.36(2H,m), 7.03(1H,t), 7.48(1H,s), 8.56(1H,s)

## Example 25

1-[(2-Methoxy-6-methyl-5-propylpyridin-3-yl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

- 25 Phenyl N-(2-methoxy-6-methyl-5-propylpyridin-3-yl)thiocarbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 22 to obtain the titled compound.

yield : 55%

- 30 m.p. : 143-144°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 0.93(3H,t), 1.66(2H,m), 2.17(3H,s), 2.65(2H,t), 3.38(4H,t), 3.79(6H,s), 3.98(3H,s), 4.15(4H,t), 6.11(3H,m), 7.43(1H,s), 8.25(1H,s)

- 35 Example 26

1-[(2-Methoxy-5-methyl-6-propylpyridin-3-yl)aminothiocarbonyl]-4-(3,5

- 29 -

-dimethoxyphenyl)piperazine:

Phenyl N-(2-methoxy-5-methyl-6-propylpyridin-3-yl)thiocarbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 22 to obtain the titled compound.

5 yield : 52%

m.p. : 183-184°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 0.98(3H,t), 1.72(2H,m), 2.17(3H,s), 2.62(2H,t), 3.39(4H,t), 3.79(6H,s), 3.96(3H,s), 4.19(4H,t), 6.15(3H,m), 7.42(1H,s), 8.08(1H,s)

10 Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>32</sub>N<sub>4</sub>O<sub>3</sub>S<sub>1</sub> 444.2195, found 444.2171

Example 27

1-[(2-Methoxy-5-methyl-6-propylpyridin-3-yl)aminothiocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

15 Phenyl N-(2-methoxy-5-methyl-6-propylpyridin-3-yl)thiocarbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 22 to obtain the titled compound.

yield : 49%

m.p. : 195-197°C

20 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 0.98(3H,t), 1.73(2H,m), 2.18(6H,s), 2.34(3H,s), 2.62(2H,t), 3.47(4H,t), 3.96(3H,s), 4.01(4H,t), 6.59(3H,m), 7.02(1H,s), 7.99(1H,s)

Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>32</sub>N<sub>4</sub>O<sub>1</sub>S<sub>1</sub> 412.2296, found 412.2266

25 Example 28

1-[(2-Methoxy-5-methyl-6-propylpyridin-3-yl)aminothiocarbonyl]-4-(3-hydroxyphenyl)piperazine:

Phenyl N-(2-methoxy-5-methyl-6-propylpyridin-3-yl)thiocarbamate and 1-(3-hydroxyphenyl)piperazine were reacted by the same way with the

30 example 22 to obtain the titled compound.

yield : 48%

m.p. : 160-162°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 0.98(3H,t), 1.72(2H,m), 2.22(3H,s), 2.61(3H,t), 3.31(4H,t), 3.95(3H,s), 4.10(4H,t), 6.45(3H,m), 7.12(1H,t), 7.41(1H,s), 8.08(1H,s)

35

Mass(EI) m/z : Calcd for C<sub>21</sub>H<sub>28</sub>N<sub>4</sub>O<sub>2</sub>S<sub>1</sub> 400.1932, found 400.1969

## Example 29

1-[N-(2-Methoxy-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

- 5 Phenyl N-(2-methoxy-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl) thiocarbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 22 to obtain the titled compound.  
yield : 55%

m.p. : 169-170°C

- 10 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.10(2H,m), 2.89(4H,m), 3.30(4H,t), 3.77(6H,s), 3.98(3H,s), 4.20(4H,t), 6.05(3H,m), 7.37(1H,s), 8.25(1H,s)

## Example 30

1-[N-(2-Methoxy-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl)aminothiocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

- 15 Phenyl N-(2-methoxy-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl) thiocarbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 22 to obtain the titled compound.  
yield : 53%

- 20 m.p. : 159-161°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.09(2H,m), 2.28(6H,s), 2.87(4H,m), 3.67(4H,t), 4.00(3H,s), 4.21(4H,t), 6.57(3H,m), 6.93(1H,s), 8.24(1H,s)

## Example 31

- 25 1-[(2-Methoxy-5,6,7,8-tetrahydroquinolin-3-yl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

Phenyl N-[(2-methoxy-5,6,7,8-tetrahydroquinolin-3-yl)thiocarbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 22 to obtain the titled compound.

- 30 yield : 56%

m.p. : 160-161°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.77(2H,m), 1.83(2H,m), 2.70(2H,t), 2.76(2H,t), 3.38(4H,t), 3.79(6H,s), 3.96(3H,s), 4.16(4H,t), 6.12(3H,m), 7.45(1H,s), 8.03(1H,s)

35

## Example 32

- 31 -

1-[(2-Methoxy-5,6,7,8-tetrahydroquinolin-3-yl)aminothiocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(2-methoxy-5,6,7,8-tetrahydroquinolin-3-yl)thiocarbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with  
5 the example 22 to obtain the titled compound.

yield : 54%

m.p. : 200-201 °C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 1.77(2H,m), 1.84(2H,m), 2.34(6H,s), 2.71(3H,t),  
2.75(3H,t), 3.47(4H,t), 3.97(3H,s), 4.42(4H,t), 6.35(3H,m), 6.91(1H,s),  
10 7.91(1H,s)

#### Example 33

1-[(5,6-Dimethyl-2-methylaminopyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

15 Phenyl N-(5,6-dimethyl-2-methylaminopyridin-3-yl)carbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 53%

m.p. : 150-151 °C

20 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 2.29(3H,s), 2.48(3H,s), 3.29(4H,t), 3.45(3H,s), 3.77(6H,s), 3.79(4H,t), 6.10(3H,m), 7.40(1H,s)

#### Example 34

25 1-[(5,6-Dimethyl-2-methylaminopyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(5,6-dimethyl-2-methylaminopyridin-3-yl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 52%

30 m.p. : 160-162 °C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 2.30(9H,s), 2.48(3H,s), 3.31(4H,t), 3.46(3H,s), 3.78(4H,t), 6.60(3H,m), 7.41(1H,s)

#### Example 35

35 1-[(5-Ethyl-6-methyl-2-methylaminopyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

- 32 -

Phenyl N-(5-ethyl-6-methyl-2-methylaminopyridin-3-yl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

yield : 56%

5 m.p. : 143-145°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.22(3H,t), 2.28(6H,s), 2.52(3H,s), 2.72(2H,q), 3.29(4H,t), 3.45(3H,s), 3.78(4H,t), 6.59(3H,m), 7.41(1H,s)

Example 36

10 1-[(2-Methylamino-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

Phenyl N-(2-methylamino-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl)carbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

15 yield : 49%

m.p. : 148-150°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.09(2H,m), 2.95(4H,m), 3.30(4H,t), 3.47(3H,s), 3.77(4H,t), 3.80(6H,s), 6.10(3H,m), 7.49(1H,s)

20 Example 37

1-[(2-Methylamino-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(2-methylamino-6,7-dihydro-5H-cyclopenta[b]pyridin-3-yl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

25

yield : 48%

m.p. : 185-187°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.14(2H,m), 2.29(6H,s), 2.95(4H,m), 3.32(4H,t), 3.47(3H,s), 3.79(4H,t), 6.59(3H,m), 7.48(1H,s)

30

Example 38

1-[(5,6-Dimethyl-2-(4'-t-butoxycarbonylpiperazinyl)pyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

Phenyl N-[5,6-dimethyl-2-(4'-t-butoxycarbonylpiperazinyl)pyridin-3-yl]carbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 1 to obtain the titled compound.

35

- 33 -

yield : 58%

m.p. : 74-75°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.46(9H,s), 2.20(3H,s), 2.21(3H,s), 2.90(4H,t),  
3.20(4H,t), 3.55(4H,t), 3.65(4H,t), 3.98(3H,s), 6.02(3H,m), 8.20(1H,s)

5

## Example 39

1-([5,6-Dimethyl-2-(4'-t-butoxycarbonylpiperazinyl)pyridin-3-yl]  
aminocarbonyl)-4-(3,5-dimethylphenyl)piperazine:

- Phenyl N-[5,6-dimethyl-2-(4'-t-butoxycarbonylpiperazinyl)pyridin-3-yl]  
10 carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the  
same way with the example 1 to obtain the titled compound.

yield : 56%

m.p. : 155-156°C

- <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.48(9H,s), 2.22(3H,s), 2.29(6H,s), 2.35(3H,s),  
15 2.95(4H,t), 3.25(4H,t), 3.57(4H,t), 3.67(4H,t), 6.59(3H,m), 8.21(1H,s)

## Example 40

1-([5-Ethyl-6-methyl-2-(4'-t-butoxycarbonylpiperazinyl)pyridin-3-yl]  
aminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine:

- 20 Phenyl N-[5-ethyl-6-methyl-2-(4'-t-butoxycarbonylpiperazinyl)  
pyridin-3-yl]carbamate and 1-(3,5-dimethoxyphenyl)piperazine were  
reacted by the same way with the example 1 to obtain the titled  
compound.

yield : 52%

- 25 m.p. : 119-120°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.25(3H,t), 1.48(9H,s), 2.38(3H,s), 2.51(2H,q),  
2.96(4H,t), 3.27(4H,t), 3.58(8H,m), 3.78(6H,s), 6.08(3H,m), 8.24(1H,s)

## Example 41

- 30 1-([5-Ethyl-6-methyl-2-(4'-t-butoxycarbonylpiperazinyl)pyridin-3-yl]  
aminocarbonyl)-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-[5-ethyl-6-methyl-2-(4'-t-butoxycarbonylpiperazinyl)  
pyridin-3-yl]carbamate and 1-(3,5-dimethylphenyl)piperazine were  
reacted by the same way with the example 1 to obtain the titled

- 35 compound.

yield : 50%

- 34 -

m.p. : 126-128°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 1.20(3H,t), 1.49(9H,s), 2.29(6H,s), 2.39(3H,s),  
2.52(2H,q), 2.98(4H,t), 3.23(4H,t), 3.59(8H,m), 6.59(3H,m), 7.58(1H,s),  
8.26(1H,s)

5

#### Example 42

1-[(5,6-Dimethyl-2-piperazinylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

- 1-[(5,6-Dimethyl-2-(4'-t-butoxycarbonylpiperazinyl)pyridin-3-yl)  
10 aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine(0.218g, 0.4mmol) was  
dissolved in dichloromethane : nitromethane = 2 : 1(10ml) and  
anisole(0.26g, 2.4mmol) and aluminum chloride(0.3g, 2.4mmol) were  
added slowly thereto. The mixture was stirred at room temperature for  
20min. Distilled water(50ml) was added into the mixture and the  
15 mixture was made basic with saturated NaHCO<sub>3</sub> and extracted with  
dichloromethane and then concentrated under the reduced pressure to  
remove the solvent. The concentrate was purified by column  
chromatography(methanol : dichloromethane = 8:1) to obtain the titled  
compound.

20 yield : 89%

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 2.21(3H,s), 2.35(3H,s), 3.02(4H,t), 3.34(4H,t),  
3.59(4H,t), 3.62(4H,t), 3.78(6H,s), 6.08(3H,m), 8.18(1H,s)

25 

#### Example 43

1-[(5,6-Dimethyl-2-piperazinylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

- 1-[(5,6-Dimethyl-2-(4'-t-butoxycarbonylpiperazinyl)pyridin-3-yl)  
aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the  
30 same way with the example 42 to obtain the titled compound.  
yield : 85%

m.p. : 103-105°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 2.16(3H,s), 2.24(6H,s), 2.40(3H,s), 3.30(4H,t),  
3.44(4H,t), 3.50(4H,t), 3.81(4H,t), 6.95(3H,m), 7.72(1H,s)

35

#### Example 44



- 35 -

1-[(5-Ethyl-6-methyl-2-piperazinylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

1-[(5-Ethyl-6-methyl-2-(4'-t-butoxycarbonylpiperazinyl)pyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the example 42 to obtain the titled compound.

yield : 88%

m.p. : 68-70°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.20(3H,t), 2.40(3H,s), 2.52(2H,q), 2.75(4H,t), 3.32(4H,t), 3.70(8H,m), 3.78(6H,s), 6.09(3H,m), 7.68(1H,s), 8.23(1H,s)

10

Example 45

1-[(5-Ethyl-6-methyl-2-piperazinylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(5-Ethyl-6-methyl-2-(4'-t-butoxycarbonylpiperazinyl)pyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 42 to obtain the titled compound.

yield : 85%

m.p. : 100-102°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.20(3H,t), 2.28(6H,s), 2.39(3H,s), 2.65(2H,q), 2.76(4H,t), 3.00(4H,t), 3.23(4H,t), 3.70(4H,t), 6.58(3H,m), 7.66(1H,s), 8.24(1H,s)

20

Example 46

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

25

Phenyl N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)carbamate(200mg, 0.67mmol) and 1-(3,5-dimethoxyphenyl)piperazine(150mg, 0.67mmol) were dissolved in anhydrous tetrahydrofuran(15ml) and DBU(100mg, 0.67mmol) was added. The mixture was stirred at room temperature for 2 hrs and concentrated under the reduced pressure to remove tetrahydrofuran. The concentrate was purified by column chromatography(ethylacetate : hexane = 1:2) to obtain the titled compound.

yield : 83%

m.p. : 149-151°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.57(3H,s), 2.65(3H,s), 3.28(4H,t,J=4.65Hz), 3.70(4H,t,

35

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J=4.65Hz), 3.79(6H,s), 4.06(3H,s), 6.09(1H,s), 6.14(2H,d), 6.94(1H,s),  
8.87(1H,s)

## Example 47

- 5 1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 46 to obtain the titled compound.

- 10 yield : 82%

m.p. : 66-69°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.31(6H,s), 2.57(3H,s), 2.65(3H,s), 3.08(4H,t),  
3.30(4H,t), 4.10(3H,s), 6.71(2H,d), 6.94(1H,s), 8.89(1H,s)

- 15 Example 48

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-difluorophenyl)piperazine:

Phenyl N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)carbamate and 1-(3,5-difluorophenyl)piperazine were reacted by the same way with the

- 20 example 46 to obtain the titled compound.

yield : 77%

m.p. : 180-181°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.57(3H,s), 2.65(3H,s), 3.33(4H,t, J=5.0Hz), 3.74(4H,t,  
J=5.0Hz), 4.07(3H,s), 6.37(1H,s), 6.46(2H,d), 6.93(1H,s), 8.85(1H,s)

- 25

## Example 49

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dichlorophenyl)piperazine:

Phenyl N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)carbamate and

- 30 1-(3,5-dichlorophenyl)piperazine were reacted by the same way with the example 46 to obtain the titled compound.

yield : 81%

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.57(3H,s), 2.65(3H,s), 3.34(4H,t), 3.78(4H,t),

- 35 4.04(3H,s), 6.93(3H,m), 8.80(1H,s)

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## Example 50

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(2,3-dimethylphenyl)piperazine:

- 5 Phenyl N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)carbamate and 1-(2,3-dimethylphenyl)piperazine were reacted by the same way with the example 46 to obtain the titled compound.

yield : 81%

m.p. : 173-174°C

- 10 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.29(6H,s), 2.58(3H,s), 2.65(3H,s), 2.98(4H,t), 3.70(4H,t), 4.06(3H,s), 6.91(1H,d), 6.97(1H,s), 7.10(1H,t), 8.89(1H,s)

## Example 51

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)piperazine:

- 15 Phenyl N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)carbamate and 1-(2-methoxyphenyl)piperazine were reacted by the same way with the example 46 to obtain the titled compound.

yield : 79%

m.p. : 153-154°C

- 20 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.58(3H,s), 2.65(3H,s), 3.15(4H,t), 3.73(4H,t), 3.90(3H,s), 4.06(3H,s), 6.91(1H,d), 6.96(1H,d), 6.97(1H,s), 7.10(1H,t), 8.89(1H,s)

## Example 52

- 25 1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3-hydroxyphenyl)piperazine:

Phenyl N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)carbamate and 1-(3-hydroxyphenyl)piperazine were reacted by the same way with the example 46 to obtain the titled compound.

- 30 yield : 76%

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.60(3H,s), 2.72(3H,s), 3.34(4H,t), 3.79(4H,t), 3.98(3H,s), 6.45(3H,m), 6.98(1H,m), 8.97(1H,s)

## 35 Example 53

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminothiocabonyl]-4-(3,5

- 38 -

-dimethoxyphenyl)piperazine:

Phenyl N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)thiocarbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 22 to obtain the titled compound.

5 yield : 77%

m.p. : 167-169°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.58(3H,s), 2.68(3H,s), 3.47(4H,t), 3.81(6H,s), 4.05(3H,s), 4.36(4H,t), 6.42(3H,m), 7.49(1H,s), 9.05(1H,s)

10 Example 54

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminothiocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)thiocarbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with

15 the example 22 to obtain the titled compound.

yield : 75%

m.p. : 176-177°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.34(6H,s), 2.58(3H,s), 2.68(3H,s), 3.48(4H,t), 4.06(3H,s), 4.43(4H,t), 7.05(3H,m), 7.52(1H,s), 9.04(1H,s)

20

Example 55

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminothiocarbonyl]-4-(3-hydroxyphenyl)piperazine:

Phenyl N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)thiocarbamate and 25 1-(3-hydroxyphenyl)piperazine were reacted by the same way with the example 22 to obtain the titled compound.

yield : 71%

m.p. : 114-115°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.56(3H,s), 2.75(3H,s), 3.68(4H,t), 4.05(3H,s), 30 4.45(4H,t), 7.30(4H,m), 9.03(1H,s)

Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>30</sub>N<sub>4</sub>O<sub>4</sub>S<sub>1</sub> 458.1987, found 458.2527

Example 56

1-[(5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]

35 -4-(3,5-dimethoxyphenyl)piperazine:

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-

- 39 -

dimethoxyphenyl)piperazine(100mg, 0.23mmol) was dissolved in anhydrous ethanol(15ml) and NaBH<sub>4</sub>(8.66mg) was added. The reaction solution was stirred at room temperature for 2 hours. The mixture was concentrated under the reduced pressure to remove ethanol and purified by column chromatography (ethylacetate : hexane = 2:1) to obtain the titled compound.

yield : 97%

m.p. : 124-126°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.48(3H,d), 2.42(3H,s), 3.27(4H,t), 3.69(4H,t),  
3.79(6H,s), 3.99(3H,s), 5.03(1H,q), 6.09(1H,s), 6.15(2H,d), 6.90(1H,s),  
8.46(1H,s)

Mass(EI) m/z : Calcd for C<sub>22</sub>H<sub>30</sub>N<sub>4</sub>O<sub>5</sub> 430.2216, found 430.2265

#### Example 57

1-[[5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 56 to obtain the titled compound.

yield : 95%

m.p. : 153-154°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.48(3H,d), 2.30(6H,s), 2.42(3H,s), 3.26(4H,t),  
3.68(4H,t), 3.99(3H,s), 5.05(1H,q), 6.71(2H,d), 6.96(1H,s), 8.46(1H,s)

Mass(EI) m/z : Calcd for C<sub>22</sub>H<sub>30</sub>N<sub>4</sub>O<sub>3</sub> 398.2317, found 398.2343

25

#### Example 58

1-[[5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl]-4-(2,3-dimethylphenyl)piperazine:

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(2,3-dimethylphenyl)piperazine was reacted by the same way with the example 56 to obtain the titled compound.

yield : 96%

m.p. : 100-102°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.47(3H,d), 1.59(3H,s), 2.25(3H,s), 2.28(3H,s),  
2.43(3H,s), 2.93(4H,t), 3.66(4H,t), 3.99(3H,s), 5.05(1H,q), 6.93(3H,m),  
7.11(1H,m), 8.48(1H,s)

## Example 59

1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3,5-difluorophenyl)piperazine:

- 5 1-([5-Acetyl-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3,5-difluorophenyl)piperazine was reacted by the same way with the example 56 to obtain the titled compound.

yield : 97%

m.p. : 184-186°C

- 10 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.48(3H,d), 2.50(3H,s), 3.30(4H,t), 3.70(4H,t), 4.11(3H,s), 5.06(1H,q), 6.33(1H,s), 6.42(2H,d), 6.92(1H,s), 8.54(1H,s)

## Example 60

1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3,5-dichlorophenyl)piperazine:

- 15 1-([5-Acetyl-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3,5-dichlorophenyl)piperazine was reacted by the same way with the example 56 to obtain the titled compound.

yield : 95%

- 20 m.p. : 197-200°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.46(3H,d), 2.41(3H,s), 3.28(4H,t), 3.66(4H,t), 3.96(3H,s), 5.20(1H,q), 7.02(3H,m), 8.42(1H,s)

## Example 61

- 25 1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(2-methoxyphenyl)piperazine:

1-([5-Acetyl-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(2-methoxyphenyl)piperazine was reacted by the same way with the example 56 to obtain the titled compound.

- 30 yield : 97%

m.p. : 88-90°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.47(3H,d), 2.42(3H,s), 3.11(4H,t), 3.70(4H,t), 3.89(3H,s), 3.99(3H,s), 5.03(1H,q), 6.89(3H,m), 6.94(1H,s), 7.05(1H,m), 8.48(1H,s)

35

## Example 62

1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3-hydroxyphenyl)piperazine:

1-[5-Acetyl-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl]-4-(3-hydroxyphenyl)piperazine was reacted by the same way with the example 56 to obtain the titled compound.

yield : 87%

m.p. : 194-196°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.47(3H,d), 2.41(3H,s), 3.27(4H,t), 3.79(4H,t), 3.98(3H,s), 5.04(1H,q), 6.57(3H,m), 6.90(1H,s), 7.13(1H,t), 8.41(1H,s)

10

Example 63

1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminothiocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine:

1-([5-Acetyl-2-methoxy-6-methylpyridin-3-yl]aminothiocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the example 56 to obtain the titled compound.

yield : 89%

m.p. : 189-190°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.47(3H,d), 2.43(3H,s), 3.35(4H,t), 3.78(6H,s), 3.97(3H,s), 4.09(4H,t), 5.05(1H,q), 6.07(3H,m), 7.35(1H,s), 8.42(1H,s)

20

Example 64

1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminothiocarbonyl)-4-(3,5-dimethylphenyl)piperazine:

1-([5-Acetyl-2-methoxy-6-methylpyridin-3-yl]aminothiocarbonyl)-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 56 to obtain the titled compound.

yield : 88%

m.p. : 170-172°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.46(3H,d), 2.29(6H,s), 2.43(3H,s), 3.43(4H,t), 3.97(3H,s), 4.10(4H,t), 5.06(1H,q), 6.60(3H,m), 7.37(1H,s), 8.40(1H,s)

30

Example 65

1-([5-(1-Hydroxy-1-methylethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine:

35

1-([5-Acetyl-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3,5-

- 42 -

- dimethoxyphenyl)piperazine(214mg, 0.50mmol) was dissolved in tetrahydrofuran(10ml) and  $\text{CH}_3\text{MgBr}$ (0.50ml, 1.50mmol) was added slowly. The mixture solution was refluxed for 15 hrs and concentrated under the reduced pressure to remove the solvent and extracted with ethylacetate, dried and filtered. The resultant was purified by column chromatography(ethylacetate : hexane = 1: 2) to obtain the titled compound.
- 5 yield : 84%
- m.p. : 146-148°C
- 10  $^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 1.64(6H,s), 2.64(3H,s), 3.25(4H,t), 3.67(4H,t), 3.78(6H,s), 3.99(3H,s), 6.07(3H,m), 6.86(1H,s), 8.47(1H,s)

## Example 66

- 1-[(5-(1-Hydroxy-1-methylethyl)-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:
- 15 1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 65 to obtain the titled compound.
- yield : 81%
- 20 m.p. : oil phase
- $^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 1.64(6H,s), 2.29(6H,s), 2.65(3H,s), 3.24(4H,t), 3.67(4H,t), 3.99(3H,s), 6.59(3H,m), 7.05(1H,s), 8.48(1H,s)

## Example 67

- 25 1-[(5-(1-Hydroxy-1-methylpropyl)-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:
- 1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine(214mg, 0.50mmol) was dissolved in tetrahydrofuran(10ml) and  $\text{C}_2\text{H}_5\text{MgBr}$ (0.50mg, 1.50mmol) was added
- 30 slowly. The mixture solution was refluxed for 15 hours and concentrated under the reduced pressure to remove the solvent and extracted with ethylacetate, dried and filtered. The resultant was purified by column chromatography(ethylacetate : hexane = 1:2) to obtain the titled compound.
- 35 yield : 76%
- m.p. : 127-129°C



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<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 0.83(3H,t), 1.63(3H,s), 1.94(2H,m), 2.61(3H,s),  
3.26(4H,t), 3.68(4H,t), 3.79(6H,s), 3.99(3H,s), 6.08(3H,m), 6.86(1H,s),  
8.44(1H,s)

## 5 Example 68

1-([5-(1-Hydroxy-1-methylpropyl)-2-methoxy-6-methylpyridin-3-yl]  
aminocarbonyl)-4-(3,5-dimethylphenyl)piperazine:

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-  
dimethylphenyl)piperazine was reacted by the same way with the

10 example 67 to obtain the titled compound.

yield : 74%

m.p. : 164-165°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 0.83(3H,t), 1.60(3H,s), 1.95(2H,m), 2.29(6H,s),  
2.61(3H,s), 3.23(4H,t), 3.67(4H,t), 3.99(3H,s), 6.59(3H,m), 6.87(1H,s),

15 8.45(1H,s)

## Example 69

1-[5-([4-(3,5-Dimethoxyphenyl)piperazino]carbonyl)amino]-6-methoxy-2-  
-methylpyridin-3-ylethyl ethanthioate:

20 Triphenylphosphine(262mg, 1.0mmol) was dissolved in  
tetrahydrofuran(15ml) and diethyl azodicarboxylate(157μl, 1.0mmol) was  
added and then the mixture was stirred at 0°C for 30min.

1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)  
-4-(3,5-dimethoxyphenyl)piperazine(213mg, 0.5mmol) and thioacetic

25 acid(72μl, 1.0mmol) were dissolved in tetrahydrofuran and was added  
into the above solution. The mixture solution was stirred at 0°C for  
1hour and at room temperature for 1hour and then was concentrated  
under the reduced pressure to remove the solvent. The concentrate was  
purified by column chromatography(ethylacetate : hexane = 1:2) to

30 obtain the titled compound.

yield : 62%

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 1.55(3H,d), 2.20(3H,s), 2.39(3H,s), 3.15(4H,t),  
3.57(4H,t), 3.69(6H,s), 3.90(3H,s), 4.74(1H,q), 6.01(3H,m), 6.89(1H,s),

35 8.33(1H,s)

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## Example 70

1-[5-([4-(3,5-Dimethylphenyl)piperazino]carbonyl)amino]-6-methoxy-2-methylpyridin-3-yl]ethyl ethanthioate:

- 1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 69 to obtain the titled compound.  
yield : 60%

m.p. : oil phase

- <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.60(3H,d), 2.26(6H,s), 2.52(3H,s), 3.20(4H,t),  
3.64(4H,t), 3.96(3H,s), 4.80(1H,q), 6.56(3H,m), 6.91(1H,s), 8.38(1H,s)

## Example 71

1-([2-Methoxy-6-methyl-5-(1-sulfanylmethyl)]aminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine:

- 1-[5-([4-(3,5-Dimethoxyphenyl)piperazino]carbonyl)amino]-6-methoxy-2-methylpyridin-3-yl]ethyl ethanthioate(180mg, 0.37mmol) was dissolved in tetrahydrofuran(15ml) and LiAlH<sub>4</sub>(15mg, 0.4mmol) was added and then the mixture was stirred at 0°C for 20min. 2N-HCl was added the above solution. The mixture was concentrated under the reduced pressure to remove the solvent and extracted with dichloromethane, dried and filtered. The resultant was concentrated under the reduced pressure and purified by column chromatography(ethylacetate : hexane = 1:2) to obtain the titled compound.

yield : 88%

- m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.42(3H,d), 2.39(3H,s), 3.25(4H,t), 3.66(4H,t),  
3.76(6H,s), 3.96(3H,s), 5.02(1H,q), 6.17(3H,m), 6.87(1H,s), 8.41(1H,s)

## Example 72

- 1-([2-Methoxy-6-methyl-5-(1-sulfanylmethyl)]aminocarbonyl)-4-(3,5-dimethylphenyl)piperazine:

1-[5-([4-(3,5-Dimethylphenyl)piperazino]carbonyl)amino]-6-methoxy-2-methylpyridin-3-yl]ethyl ethanthioate was reacted by the same way with the example 71 to obtain the titled compound.

- yield : 87%

m.p. : oil phase

- 45 -

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$ : 1.43(3H,d), 2.28(6H,s), 2.40(3H,s), 3.25(4H,t),  
3.72(4H,t), 5.03(1H,q), 6.64(3H,m), 6.88(1H,s), 8.42(1H,s)

## Exmample 73

- 5 1-[(2-Methoxy-6-methyl-5-vinylpyridin-3-yl)aminocarbonyl]-4-(3,5-  
dimethoxyphenyl)piperazine:  
1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)  
-4-(3,5-dimethoxyphenyl)piperazine was dissolved in chloroform(15ml)  
and pyridinium p-toluensulfonate(60mg, 0.23mmol) was added and then  
10 the mixture solution was refluxed 16hours. The above solution was  
concentrated under the reduced pressure to remove chloroform and  
purified by column chromatography to obtain the titled compound.  
yield : 93%  
m.p. : 140-141°C
- 15  $^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$ : 2.43(3H,s), 3.27(4H,t), 3.69(4H,t), 3.79(6H,s),  
4.00(3H,s), 5.25(1H,d), 5.65(1H,d), 6.08(1H,s), 6.13(2H,d), 6.82(1H,d),  
6.91(1H,s), 8.53(1H,s)  
Mass(EI) m/z : Calcd for  $\text{C}_{22}\text{H}_{28}\text{N}_4\text{O}_4$  412.2110, found 412.2119

## 20 Example 74

- 1-[(2-Methoxy-6-methyl-5-vinylpyridin-3-yl)aminocarbonyl]-4-(3,5-  
dimethylphenyl)piperazine:  
1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)  
-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with  
25 the example 73 to obtain the titled compound.  
yield : 94%  
m.p. : 131-132°C
- $^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$ : 1.57(3H,s), 2.31(6H,s), 2.43(1H,s), 3.25(4H,t),  
3.68(4H,t), 4.00(3H,s), 5.25(1H,d), 5.65(1H,d), 6.60(3H,m), 6.82(1H,dd),  
30 6.92(1H,s), 8.53(1H,s)  
Mass(EI) m/z : Calcd for  $\text{C}_{22}\text{H}_{28}\text{N}_4\text{O}_2$  380.2212, found 380.2236

## Example 75

- 1-[(2-Methoxy-6-methyl-5-vinylpyridin-3-yl)aminocarbonyl]-4-(3,5-  
35 difluorophenyl)piperazine:  
1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)

- 46 -

-4-(3,5-difluorophenyl)piperazine was reacted by the same way with the example 73 to obtain the titled compound.

yield : 93%

m.p. : 160-161°C

- 5 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.44(3H,s), 3.30(4H,t,J=5.5Hz), 3.68(4H,t,J=5.5Hz), 4.01(3H,s), 5.26(1H,d), 5.65(1H,d), 6.30(1H,s), 6.39(2H,d), 6.81(1H,dd), 8.53(1H,s)

Mass(EI) m/z : Calcd for C<sub>22</sub>H<sub>28</sub>N<sub>4</sub>O<sub>4</sub> 412.2110, found 412.2102

10 Example 76

1-[(5-Isopropenyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

-{[5-(1-Hydroxy-1-methylethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl}-4-(3,5-dimethoxyphenyl)piperazine was reacted by the

- 15 same way with the example 73 to obtain the titled compound.

yield : 96%

m.p. : 83-85°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.01(3H,s), 2.38(3H,s), 3.25(4H,t), 3.66(4H,t), 3.78(6H,s), 3.99(3H,s), 4.86(1H,s), 5.30(1H,s), 6.11(3H,m), 6.90(1H,s),

- 20 8.18(1H,s)

Example 77

1-[(5-Isopropenyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

- 25 1-{[5-(1-Hydroxy-1-methylethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl}-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with example 73 to obtain the titled compound.

yield : 93%

m.p. : 140-142°C

- 30 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.01(3H,s), 2.29(6H,s), 2.28(3H,s), 3.23(4H,t), 3.66(4H,t), 3.99(3H,s), 4.86(1H,s), 5.18(1H,s), 6.59(3H,m), 6.91(1H,s), 8.18(1H,s)

Example 78

- 35 Ethyl 2-(1-[5-([4-(3,5-dimethoxyphenyl)piperazino]carbonyl)amino]-6-methoxy-2-methylpyridin-3-yl)ethoxy)acetate:

- 47 -

1-([5-(1-Hydroxy)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine(0.5mmol) was dissolved in dimethylformamide(15ml) and NaH(18.5mg, 0.5mmol) was added and then the mixture solution was stirred at room temperature for 15min.

5 Ethylbromoacetate(83.5mg, 0.5mmol) was added into the above mixture and stirred at room temperature for 3hours. The mixture was concentrated under the reduced pressure to remove the solvent and purified by column chromatography(ethylacetate : hexane = 1:2) to obtain the titled compound.

10 yield : 89%

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.25(3H,t), 1.34(3H,d), 2.42(3H,s), 3.00(4H,t), 3.29(4H,t), 3.74(6H,s), 3.97(3H,s), 4.16(4H,s), 4.53(1H,q), 6.03(3H,m), 7.58(1H,s)

15

#### Example 79

4-{1-[5-([4-(3,5-Dimethoxyphenyl)piperazino]carbonyl)amino]-6-methoxy-2-methylpyridin-3-yl]ethoxy}-4-oxobutanoic acid:

1-([5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine(107mg, 0.25mmol) and dimethylaminopyridine(3mg, 0.025mmol) were dissolved in pyridine and anhydrous succinic acid(50mg, 0.5mmol) was added. The mixture was stirred at room temperature for 5hrs. Distilled water was added into the above mixture. The above solution was extracted with CH<sub>2</sub>Cl<sub>2</sub> and the organic phase washed with 1N-HCl and then concentrated under the reduced pressure to remove the solvent. The concentrate was purified by column chromatography(dichloromethane : methanol = 20:1) to obtain the titled compound.

25 yield : 78%

30 m.p. : 158-160°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.42(3H,d), 2.43(3H,s), 2.61(4H,m), 3.24(4H,t), 3.66(4H,t), 3.76(6H,s), 3.95(3H,s), 5.94(1H,q), 6.04(3H,m), 6.89(1H,s), 8.13(1H,s)

35 Example 80

4-{1-[5-([4-(3,5-Dimethylphenyl)piperazino]carbonyl)amino]-6-methoxy-

- 48 -

2-methylpyridin-3-yl]ethoxy)-4-oxobutanoic acid:

1-([5-(1-hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]aminocarbonyl)-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 79 to obtain the titled compound.

5 yield : 76%

m.p. : 138-140°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.43(3H,d), 2.27(6H,s), 2.55(3H,s), 2.65(4H,m), 3.24(4H,t), 3.69(4H,t), 3.95(3H,s), 5.95(1H,q), 6.60(3H,m), 6.88(1H,s), 8.11(1H,s)

10

Example 81

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

15 a) Phenyl N-(2-methoxyquinolin-3-yl)carbamate:

3-Amino-2-methoxyquinoline(4g, 23mmol) and phenyl chloroformate(4.04g, 25mmol) were dissolved in dichloromethane and stirred at room temperature for 2 hours. The above mixture was concentrated under the reduced pressure to remove dichloromethane and purified by column chromatography(hexane : ether =8:1) to obtain the titled compound.

20

yield : 75%

m.p. : oil phase

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 4.01(3H,s), 7.30(5H,s), 7.41(1H,t), 7.70(1H,d),

25

7.71(1H,d), 8.71(1H,s)

b) 1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)carbamate(148mg, 0.5mmol) and 1-(3,5-dimethoxyphenyl)piperazine(112mg, 0.5mmol) were dissolved in anhydrous tetrahydrofuran and DBU(117mg, 0.75mmol) was added. The solution was stirred at room temperature for 2 hours. The mixture was concentrated under the reduced pressure to remove tetrahydrofuran and purified by column chromatography(hexane : ether = 5:1) to obtain the titled compound.

35

yield : 81%

m.p. : 200-201°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.31(4H,t,J=5.0Hz), 3.74(4H,t), 3.79(6H,s), 4.17(3H,s), 6.09(1H,s), 6.17(2H,s), 7.35(1H,t), 7.49(1H,t), 7.71(1H,d), 7.78(1H,d), 8.78(1H,s)

5 Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>26</sub>N<sub>4</sub>O<sub>4</sub> 422.1954, found 422.1952

Example 82

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)  
piperazine:

10 Phenyl N-(2-methoxyquinolin-3-yl)carbamate and  
1-(3,5-dimethylphenyl)piperazine were reacted by the same way with  
the example 81 to obtain the titled compound.

yield : 79%

m.p. : 143-145°C

15 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.30(6H,s), 3.29(4H,t), 3.80(4H,t), 4.18(3H,s),  
6.62(3H,m), 7.36(1H,t), 7.49(1H,t), 7.71(1H,d), 7.78(1H,d), 8.79(1H,s)

Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>26</sub>N<sub>4</sub>O<sub>2</sub> 390.2055, found 390.2066

Example 83

20 1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(2,3-dimethylphenyl)  
piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

1-(2,3-dimethylphenyl)piperazine were reacted by the same way with  
the example 81 to obtain the titled compound.

25 yield : 83%

m.p. : 174-175°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.20(3H,s), 2.39(3H,s), 3.28(4H,t), 3.69(4H,t),  
3.93(3H,s), 5.98(1H,s), 6.30(1H,t), 6.37(1H,s), 6.39(1H,s), 6.63(1H,s)

30 Example 84

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-difluorophenyl)  
piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

35 1-(3,5-difluorophenyl)piperazine were reacted by the same way with the  
example 81 to obtain the titled compound.

yield : 78%

- 50 -

m.p. : 158-159°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.32(4H,t,J=5.0Hz), 3.72(4H,t,J=5.0Hz), 4.19(3H,s),  
6.29(1H,s), 6.39(2H,d), 7.36(1H,t), 7.50(1H,t), 7.71(1H,d), 7.81(1H,d),  
8.78(1H,s)

5

## Example 85

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dichlorophenyl)  
piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

10 1-(3,5-dichlorophenyl)piperazine were reacted by the same way with the  
example 81 to obtain the titled compound.

yield : 56%

m.p. : 156-158°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.33(4H,t), 3.73(4H,t), 4.21(3H,s) 6.79(1H,s),  
15 6.83(1H,d), 6.93(1H,t), 7.26(1H,t), 7.38(1H,t), 7.52(1H,t), 7.71(1H,d),  
7.83(1H,d)

Mass(EI) m/z : Calcd for C<sub>21</sub>H<sub>20</sub>N<sub>4</sub>O<sub>2</sub>Cl<sub>2</sub> 430.0963, found 430.0977

## Example 86

20 1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(2-fluorophenyl)piperazine:  
Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

1-(2-fluorophenyl)piperazine were reacted by the same way with the  
example 81 to obtain the titled compound.

yield : 81%

25 m.p. : 156-158°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.18(4H,t), 3.74(4H,t), 4.18(3H,s), 6.99(2H,q),  
7.07(2H,m), 7.35(2H,m), 7.50(1H,t), 7.70(1H,d), 7.77(1H,d)

## Example 87

30 1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(2-chlorophenyl)piperazine:  
Phenyl N-(2-methoxyquinoline-3-yl)carbamate and

1-(2-chlorophenyl)piperazine were reacted by the same way with the  
example 81 to obtain the titled compound.

yield : 78%

35 m.p. : 79-80°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.32(4H,t), 3.74(4H,t), 4.20(3H,s), 6.82(2H,q),



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6.94(2H,m), 7.34(2H,m), 7.48(1H,d), 7.70(1H,d), 7.78(1H,d)

Example 88

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3-chlorophenyl)piperazine:

5 Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

1-(3-chlorophenyl)piperazine were reacted by the same way with the example 81 to obtain the titled compound.

yield : 73%

m.p. : 97-98°C

10 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.31(4H,t), 3.73(4H,t), 4.18(3H,s), 6.82(1H,d),  
6.87(1H,d), 6.92(1H,s), 7.21(1H,t), 7.32(1H,s), 7.37(1H,t), 7.51(1H,t),  
7.70(1H,d), 7.78(1H,d), 8.80(1H,s)

Example 89

15 1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3-hydroxyphenyl)  
piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

1-(3-hydroxyphenyl)piperazine were reacted by the same way with the example 81 to obtain the titled compound.

20 yield : 75%

m.p. : 190-191°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.33(4H,t), 3.80(4H,t), 4.19(3H,s), 6.47(1H,s),  
6.62(2H,s), 7.16(1H,t), 7.32(1H,s), 7.37(1H,t), 7.51(1H,t), 7.72(1H,d),  
7.78(1H,d), 8.78(1H,s)

25

Example 90

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)  
piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

30 1-(2-methoxyphenyl)piperazine were reacted by the same way with the example 81 to obtain the titled compound.

yield : 88%

m.p. : 159-161°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.28(4H,t), 3.71(4H,t), 3.81(3H,s), 4.18(3H,s),  
35 6.52(2H,s), 6.62(1H,s), 7.23(1H,t), 7.31-7.53(3H,m), 7.72(2H,m), 8.81(1H,s)

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## Example 91

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(2-methylthiophenyl)  
piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

- 5 1-(2-methylthiophenyl)piperazine were reacted by the same way with  
the example 81 to obtain the titled compound.

yield : 78%

m.p. : 147-149°C

- <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.44(3H,s), 3.07(4H,t), 3.75(4H,t), 4.18(3H,s),  
10 7.13(3H,m), 7.18(1H,d), 7.39(2H,m), 7.70(3H,m), 8.81(1H,s)

## Example 92

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3-isopropoxyphenyl)  
piperazine:

- 15 Phenyl N-(2-methoxyquinolin-3-yl)carbamate and  
1-(3-isopropoxyphenyl)piperazine were reacted by the same way with  
the example 81 to obtain the titled compound.

yield : 93%

m.p. : 111-113°C

- 20 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.34(6H,d), 3.30(4H,t), 3.74(4H,t), 4.18(3H,s),  
4.55(1H,m), 6.49(2H,s), 7.05(1H,s), 7.20(1H,t), 7.32(1H,s), 7.37(1H,t),  
7.50(1H,t), 7.70(1H,d), 7.77(1H,d), 8.80(1H,s)

## Example 93

- 25 1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3-cyclopropylmethoxy  
phenyl)piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

1-(3-cyclopropylmethoxyphenyl)piperazine were reacted by the same  
way with the example 81 to obtain the titled compound.

- 30 yield : 90%

m.p. : 146-147°C ;

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 0.36(2H,t), 0.65(2H,m), 1.28(1H,m), 3.31(4H,t),  
3.75(4H,t), 3.80(2H,d), 4.18(3H,s), 6.50(1H,s), 6.60(2H,s), 7.19(1H,t),  
7.32(1H,s), 7.37(1H,t), 7.50(1H,t), 7.70(1H,d), 7.77(1H,d), 8.79(1H,s)

35

## Example 94

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1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(2-methoxy-5-methylphenyl)piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

1-(2-methoxy-5-methylphenyl)piperazine were reacted by the same way

5 with the example 81 to obtain the titled compound.

yield : 76%

m.p. : 115-116°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.30(3H,s), 3.14(4H,t), 3.75(4H,t), 3.87(3H,s),  
4.18(3H,s), 6.79(2H,m), 6.84(1H,d), 7.35(2H,m), 7.50(1H,t), 7.72(1H,d),  
10 7.77(1H,d), 8.82(1H,s)

Example 95

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(2-methoxy-5-phenylphenyl)piperazine:

15 Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

1-(2-methoxy-5-phenylphenyl)piperazine were reacted by the same way  
with the example 81 to obtain the titled compound.

yield : 77%

m.p. : 122-123°C

20 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.38(4H,t) 3.86(4H,t), 3.97(3H,s), 4.18(3H,s),  
7.05(2H,m), 7.34-7.45(6H,m), 7.50(1H,t), 7.56(2H,d), 7.71(2H,d),  
7.78(2H,d), 8.88(1H,s)

Example 96

25 1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(5-methoxy-2-methylphenyl)piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)carbamate and

1-(5-methoxy-2-methylphenyl)piperazine were reacted by the same way  
with the example 81 to obtain the titled compound.

30 yield : 82%

m.p. : 128-130°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.30(3H,s), 3.37(4H,t), 3.84(4H,t), 3.78(3H,s),  
3.97(3H,s), 7.05(2H,m), 7.13(1H,d), 7.38(3H,m), 7.62(1H,d), 7.80(1H,s),  
8.88(1H,s)

35

Example 97

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(1-naphthyl)piperazine:  
Phenyl N-(2-methoxyquinolin-3-yl)carbamate and  
1-(1-naphthyl)piperazine were reacted by the same way with the  
example 81 to obtain the titled compound.

5 yield : 68%

m.p. : 158-160°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.22(4H,t), 3.86(4H,t), 4.20(3H,s), 7.13(1H,d),  
7.38(2H,m), 7.43(1H,t), 7.53(3H,m), 7.62(1H,d), 7.72(1H,d), 7.80(1H,d),  
7.86(1H,d), 8.24(1H,d), 8.84(1H,s)

10

#### Example 98

1-[N-(2-Methoxyquinolin-3-yl)-N-methylaminocarbonyl]-4-(3,5-  
dimethoxyphenyl)piperazine:

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)  
15 piperazine(106mg, 0.25mmol) was dissolved in dimethylformamide(15ml)  
and sodium hydride(6.0mg, 0.25mmol) was added and the solution was  
stirred at room temperature for 15 min. Iodomethane(35mg, 0.25mmol)  
was added to the above solution. The mixture was stirred at room  
temperature for 16 hours and concentrated under the reduced pressure  
20 to remove dimethylformamide. The concentrate was purified by column  
chromatography(ethylacetate : hexane = 1:2) to obtain the titled  
compound.

yield : 93%

m.p. : 88-89°C

25 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.93(4H,t), 3.17(3H,s), 3.34(4H,t), 3.72(6H,s),  
4.15(3H,t), 5.95(2H,s), 5.98(1H,s), 7.40(1H,t), 7.61(2H,m), 7.73(1H,s),  
7.84(1H,d)

Mass(EI) m/z : Calcd for C<sub>24</sub>H<sub>28</sub>N<sub>4</sub>O<sub>4</sub> 436.2110, found 436.2105

#### 30 Example 99

1-[N-Ethyl-N-(2-methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethox  
yphenyl)piperazine:

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)  
piperazine(106mg, 0.25mmol) was dissolved in dimethylformamide(15ml)  
35 and was sodium hydride(6.0mg, 0.25mmol) was added and the solution  
was stirred at room temperature for 15 min. Iodoethane(35mg,

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0.25mmol) was added to the above solution. The mixture was stirred at room temperature for 16 hours and concentrated under the reduced pressure to remove dimethylformamide. The concentrate was purified by column chromatography(ethylacetate : hexane = 1:2) to obtain the titled compound.

yield : 91%

m.p. : 118-120°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.16(3H,t), 2.89(4H,t), 3.30(4H,t), 3.63(2H,m), 3.71(6H,s), 4.13(3H,s), 5.93(2H,s), 5.98(1H,s), 7.41(1H,t), 7.60(1H,t), 7.66(1H,d), 7.71(1H,s), 7.84(1H,d)

Mass(EI) m/z : Calcd for C<sub>25</sub>H<sub>30</sub>N<sub>4</sub>O<sub>4</sub> 450.2227, found 450.2206

#### Example 100

1-[N-Isopropyl-N-(2-methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)phenyl:

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl) piperazine(106mg, 0.25mmol) was dissolved in dimethylformamide(15ml) and sodium hydride(6.0mg, 0.25mmol) was added and the reaction solution was stirred at room temperature for 15 min.

2-Propyliodide(42mg, 0.25mmol) was added to the above solution. The mixture was stirred at room temperature for 16 hours and concentrated under the reduced pressure to remove the dimethylformamide. The concentrate was purified by column chromatography(ethylacetate : hexane = 1:2) to obtain the titled compound.

yield : 87%

m.p. : 123-125°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.21(6H,d), 2.79(4H,t), 3.29(4H,t), 3.70(6H,s), 4.08(3H,s), 4.41(1H,m), 5.90(2H,s), 5.96(1H,s), 7.43(1H,t), 7.63(1H,t), 7.69(1H,d), 7.75(1H,s), 7.83(1H,d)

#### Example 101

1-[N-Cyclopropylmethyl-N-(2-methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

1-[(2-methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl) piperazine(106mg, 0.25mmol) was dissolved in dimethylformamide(15ml) and sodium hydride(6.2mg, 0.26mmol) was added and the solution was

- 56 -

stirred at room temperature for 15 min. Bromomethylcyclopropane(22mg, 0.26mmol) was added to the above solution. The mixture was stirred at room temperature for 16 hours and concentrated under the reduced pressure to remove dimethylformamide. The concentrate was purified by column chromatography(ethylacetate : hexane = 1:2) to obtain the titled compound.

yield : 78%

m.p. : 118-120°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 0.41(2H,m), 0.85(2H,m), 1.28(1H,m), 2.88(4H,t), 3.24(4H,t), 3.42(2H,d), 3.71(6H,s), 4.13(3H,s), 5.94(3H,s), 7.44(1H,d), 7.62(1H,d), 7.78(3H,m)

#### Example 102

1-[N-Benzyl-N-(2-methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:  
1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine(114mg, 0.27mmol) was dissolved in dimethylformamide(15ml) and sodium hydride(6.6mg, 0.27mmol) was added and the solution was stirred at room temperature for 15 min. Benzylbromide(46mg, 0.27mmol) was added to the above solution. The mixture was stirred at room temperature for 16 hours and concentrated under the reduced pressure to remove dimethylformamide. The concentrate was purified by column chromatography(ethylacetate : hexane = 1:2) to obtain the titled compound.

yield : 90%

m.p. : oil phase

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.92(4H,t), 3.39(4H,t), 3.72(6H,s), 4.13(3H,s), 4.79(2H,s), 6.01(3H,m), 7.21(1H,m), 7.25(2H,m), 7.33(3H,m), 7.51(1H,s), 7.57(2H,m), 7.81(2H,d)

30

#### Example 103

1-[N-(2-Methoxyquinolin-3-yl)-N-methylaminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:  
1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 98 to obtain the titled compound.

35

- 57 -

yield : 92%

m.p : 142-143°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.27(6H,d), 2.90(4H,t), 3.17(3H,s), 3.34(4H,t),  
4.15(3H,s), 6.41(2H,s), 6.49(1H,s), 7.40(1H,t), 7.63(1H,t), 7.65(1H,d),  
7.73(1H,s), 7.84(1H,d)

Mass(EI) m/z : Calcd for C<sub>24</sub>H<sub>28</sub>N<sub>4</sub>O<sub>2</sub> 404.2212, found 404.2225

## Example 104

1-[N-Ethyl-N-(2-methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 99 to obtain the titled compound.

yield : 89%

m.p. : 84-86°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.16(3H,t), 2.21(6H,s), 2.87(4H,t), 3.30(4H,t),  
3.64(2H,q), 4.13(3H,t), 6.40(2H,s), 6.48(1H,s), 7.40(1H,t), 7.62(1H,t),  
7.66(1H,d), 7.71(1H,s), 7.84(1H,d)

## Example 105

1-[N-Isopropyl-N-(2-methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 100 to obtain the titled compound.

yield : 84%

m.p. : 114-115°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.21(6H,d), 2.20(6H,s), 2.77(4H,t), 3.28(4H,t),  
4.08(3H,s), 4.39(1H,m), 6.37(2H,s), 6.46(1H,s), 7.41(1H,t), 7.63(1H,t),  
7.69(1H,d), 7.75(1H,s), 7.83(1H,d)

## Example 106

1-[N-Benzyl-N-(2-methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 102 to

- 58 -

obtain the titled compound.

yield : 90%

m.p. : oil phase

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.24(6H,s), 2.87(4H,t), 3.31(4H,t), 4.13(3H,s),

5 4.80(2H,s), 6.42(3H,s), 7.49(1H,t), 7.62(2H,m), 7.72(2H,m)

#### Example 107

1-[N-(2-Methoxyquinolin-3-yl)-N-methylaminocarbonyl]-4-(3-isopropoxyphenyl)piperazine:

10 1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3-isopropoxyphenyl)  
piperazine was reacted by the same way with the example 98 to obtain  
the titled compound.

yield : 92%

m.p. : oil phase

15 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.28(6H,d), 2.97(4H,t), 3.18(3H,s), 3.37(4H,t),  
4.14(3H,s), 4.49(1H,m), 6.41(3H,m), 7.13(1H,m), 7.40(1H,t), 7.62(1H,t),  
7.66(1H,d), 7.74(1H,s), 7.84(1H,d)

#### Example 108

20 1-[N-Ethyl-N-(2-methoxyquinolin-3-yl)aminocarbonyl]-4-(3-isopropoxyphenyl)piperazine:

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3-isopropoxyphenyl)  
piperazine was reacted by the same way with the example 99 to obtain  
the titled compound.

25 yield : 87%

m.p. : oil phase

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 1.16(3H,t), 1.34(6H,d), 2.89(4H,t), 3.30(4H,t),  
3.63(2H,m), 4.13(3H,s), 4.55(1H,m), 6.49(2H,s), 7.05(1H,s), 7.20(1H,t),  
7.32(1H,s), 7.37(1H,t), 7.50(1H,t), 7.70(1H,d), 7.77(1H,d), 8.80(1H,s)

30

#### Example 109

1-[(2-Methoxyquinolin-3-yl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)  
piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)thiocarbamate(56mg, 0.5mmol) and  
35 1-(3,5-dimethoxyphenyl)piperazine(111mg, 0.5mmol) were dissolved in  
anhydrous tetrahydrofuran and DBU(117mg, 0.75mmol) was added. The



reaction solution was stirred at room temperature for 2 hours. The above solution was concentrated under the reduced pressure to remove tetrahydrofuran and concentrated was purified by column chromatography(Hexane : ether = 5:1) to obtain the titled compound.

5 yield : 76%

m.p. : 171-172°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.41(4H,t), 3.81(6H,s), 4.17(3H,s), 4.21(4H,t), 6.12(1H,s), 6.20(1H,d), 7.38(1H,t), 7.54(1H,t), 7.74(1H,d), 7.81(1H,d), 8.96(1H,s)

10

#### Example 110

1-[(2-Methoxyquinolin-3-yl)aminothiocarbonyl]-4-(3,5-dimethylphenyl) piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)thiocarbamate and

15 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 109 to obtain the titled compound.

yield : 79%

m.p. : 170-171°C

20 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.30(6H,s), 3.38(4H,t), 4.09(3H,s), 4.17(4H,t), 6.63(3H,m), 7.38(1H,t), 7.54(1H,t), 7.72(1H,d), 7.81(1H,d), 8.96(1H,s)

#### Example 111

1-[(2-Methoxyquinolin-3-yl)aminothiocarbonyl]-4-(3,5-difluorophenyl) piperazine:

25 Phenyl N-(2-methoxyquinolin-3-yl)thiocarbamate and

1-(3,5-difluorophenyl)piperazine were reacted by the same way with the example 109 to obtain the titled compound.

yield : 78%

m.p. : 140-142°C

30 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.44(4H,t), 4.20(4H,t), 4.25(3H,s), 6.33(2H,m), 6.45(1H,d), 7.41(1H,t), 7.56(1H,m), 7.72(1H,m), 7.97(1H,m), 8.96(1H,s)

#### Example 112

1-[(2-Methoxyquinolin-3-yl)aminothiocarbonyl]-4-(3,5-dichlorophenyl)

35 piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)thiocarbamate and

- 60 -

1-(3,5-dichlorophenyl)piperazine were reacted by the same way with the example 109 to obtain the titled compound.

yield : 62%

m.p.: 181-183°C

- 5 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.44(4H,t), 4.20(4H,t), 4.26(3H,s), 6.77(1H,s), 6.88(2H,t), 7.41(1H,t), 7.59(1H,t), 7.70(2H,m), 8.01(1H,t), 8.11(1H,s), 8.93(1H,s)

Example 113

- 10 1-[(2-Methoxyquinolin-3-yl)aminothiocarbonyl]-4-(3-methoxyphenyl) piperazine:

Phenyl N-(2-methoxyquinolin-3-yl)thiocarbamate and 1-(3-methoxyphenyl)piperazine were reacted by the same way with the example 109 to obtain the titled compound.

- 15 yield : 81%

m.p. : oil phase

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.17(4H,t), 3.89(3H,s), 4.17(4H,t), 6.90(4H,m), 7.34(1H,t), 7.48(1H,t), 7.70(1H,d), 7.77(1H,d), 8.80(1H,s)

- 20 Example 114

1-[(2-Methylquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl) piperazine:

a) Phenyl N-(2-methylquinolin-3-yl)carbamate:

- 25 3-amino-2-methylquinoline(4g, 25mmol) and phenyl chloroformate(4.04g, 25mmol) were dissolved in methylene chloride and then was stirred at room temperature for 2 hrs. The mixture solution was concentrated under the reduced pressure to remove methylene chloride and purified by column chromatography(ethylacetate : hexane = 1:10) to obtain the titled compound.

30 yield : 88%

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.77(3H,s), 7.30-7.53(9H,m), 8.67(1H,s)

- b) 1-[(2-Methylquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl) piperazine:

35 Phenyl N-(2-methylquinolin-3-yl)carbamate(140mg, 0.5mmol) and

- 61 -

1-(3,5-dimethoxyphenyl)piperazine(112mg, 0.5mmol) were dissolved in tetrahydrofuran and DBU(117mg, 0.75mmol) was added and then the mixture was stirred at room temperature for 2 hrs. The above solution was concentrated under the reduced pressure to remove tetrahydrofuran and purified by column chromatography(ethylacetate : hexane = 1:2) to obtain the titled compound.

yield : 84%

m.p. : 199-200°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.81(3H,s), 3.30(4H,t), 3.76(4H,t), 3.80(6H,s), 6.08(1H,s), 6.12(2H,d), 7.48(1H,t), 7.62(1H,t), 7.71(1H,d), 8.03(1H,d), 8.59(1H,s)

#### Example 115

1-[(2-Methylquinolin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:  
Phenyl N-(2-methylquinolin-3-yl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 114 to obtain the titled compound.

yield : 86%

m.p. : 230-232°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.31(6H,s), 2.82(3H,s), 3.29(4H,t), 3.76(4H,t), 6.60(3H,s), 7.49(1H,t), 7.63(1H,t), 7.73(1H,d), 8.05(1H,d), 8.61(1H,s)

#### Example 116

1-[(2-methylquinolin-3-yl)aminocarbonyl]-4-(2,3-dimethylphenyl)piperazine:  
Phenyl N-(2-methylquinolin-3-yl)carbamate and 1-(2,3-dimethylphenyl)piperazine were reacted by the same way with the example 114 to obtain the titled compound.

yield : 81%

m.p. : 169-170°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.28(6H,d), 2.84(3H,s), 3.00(4H,t), 3.76(4H,t), 6.94(2H,m), 7.11(1H,t), 7.49(1H,t), 7.63(1H,t), 7.72(1H,d), 8.07(1H,d), 8.64(1H,s)

35

## Example 117

1-[(2-Methoxyquinolin-3-yl)aminocarbonyl]-4-(3,5-difluorophenyl)

piperazine:

Phenyl N-(2-methylquinolin-3-yl)carbamate and

- 5 1-(3,5-difluorophenyl)piperazine were reacted by the same way with the example 114 to obtain the titled compound.

yield : 81%

m.p. : 238-240°C

- <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.81(3H,t), 3.34(4H,t), 3.77(4H,t), 6.32(1H,t),  
10 6.39(2H,d), 7.49(1H,t), 7.63(1H,t), 7.72(1H,d), 8.03(1H,d), 8.58(1H,s)

## Example 118

1-[(2-Methylquinolin-3-yl)aminocarbonyl]-4-(3,5-dichlorophenyl)

piperazine:

- 15 Phenyl N-(2-methylquinolin-3-yl)carbamate and

1-(3,5-dichlorophenyl)piperazine were reacted by the same way with the example 114 to obtain the titled compound.

yield : 65%

m.p. : 247-249°C

- 20 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.79(3H,s), 3.33(4H,t), 3.75(4H,t), 6.78(2H,s),  
6.87(1H,s), 7.49(1H,t), 7.63(1H,t), 7.72(1H,d), 8.56(1H,s)

## Example 119

1-[(2-Methylquinolin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)

- 25 piperazine:

Phenyl N-(2-methylquinolin-3-yl)carbamate and

1-(2-methoxyphenyl)piperazine were reacted by the same way with the example 114 to obtain the titled compound.

yield : 83%

- 30 m.p. : 135-136°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.82(3H,s), 3.18(4H,t), 3.79(4H,t), 3.91(3H,s),  
6.88(1H,d), 6.97(2H,s), 7.07(1H,m), 7.48(1H,t), 7.62(1H,t), 7.72(1H,d),  
8.04(1H,d), 8.63(1H,s)

- 35 Example 120

1-[(2-Methylquinolin-3-yl)aminocarbonyl]-4-(2-fluorophenyl)piperazine:

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Phenyl N-(2-methylquinolin-3-yl)carbamate and 1-(2-fluorophenyl)piperazine were reacted by the same way with the example 114 to obtain the titled compound.

yield : 84%

5 m.p. : 201-203°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.84(3H,s), 3.20(4H,t), 3.80(4H,t), 6.99(2H,m), 7.07(2H,m), 7.49(1H,t), 7.62(1H,t), 7.71(1H,d), 8.04(1H,d), 8.62(1H,s)

#### Example 121

10 1-[(2-Methylquinolin-3-yl)aminocarbonyl]-4-(2-chlorophenyl)piperazine:

Phenyl N-(2-methylquinolin-3-yl)carbamate and

1-(2-chlorophenyl)piperazine were reacted by the same way with the example 114 to obtain the titled compound.

yield : 72%

15 m.p. : 180-181°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.83(3H,s), 3.16(4H,t), 3.80(4H,t), 7.04(3H,m), 7.40(1H,d), 7.49(1H,t), 7.63(1H,t), 7.71(1H,d), 8.05(1H,d), 8.62(1H,s)

#### Example 122

20 1-[(2-Methylquinolin-3-yl)aminocarbonyl]-4-(2-methylthiophenyl)piperazine:

Phenyl N-(2-methylquinolin-3-yl)carbamate and

1-(2-methylthiophenyl)piperazine were reacted by the same way with the example 114 to obtain the titled compound.

25 yield : 76%

m.p. : 165-166°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.45(3H,s), 2.85(3H,s), 3.11(4H,t), 3.79(4H,t), 7.05(1H,m), 7.15(3H,d), 7.49(1H,t), 7.63(1H,t), 7.69(1H,d), 8.07(1H,d), 8.62(1H,s)

30

#### Example 123

1-[(2-Methylquinolin-3-yl)aminocarbonyl]-4-(2-methoxy-5-methylphenyl)piperazine:

Phenyl N-(2-methylquinolin-3-yl)carbamate and

35 1-(2-methoxy-5-methylphenyl)piperazine were reacted by the same way with the example 114 to obtain the titled compound.

yield : 80%

m.p. : oil phase

$^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  2.30(3H,s), 2.72(3H,s), 3.17(4H,t), 3.70(4H,t),  
3.87(3H,s), 6.77(1H,s), 6.82(2H,s), 7.73(4H,m), 8.60(1H,s)

5

Example 124

1-[(2-Methylquinolin-3-yl)aminocarbonyl]-4-(1-naphthyl)piperazine:

Phenyl N-(2-methylquinolin-3-yl)carbamate and

1-(1-naphthyl)piperazine were reacted by the same way with the

10 example 114 to obtain the titled compound.

yield : 64%

m.p. : 220-222°C

$^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  2.83(3H,s), 3.23(4H,t), 3.80(4H,t), 6.91(1H,s),  
7.12(1H,d), 7.44(1H,d), 7.50(3H,m), 7.61(2H,m), 7.73(1H,d), 7.86(1H,d),  
15 8.05(1H,d), 8.23(1H,d), 8.64(1H,s)

Example 125

1-[(2-Methylquinolin-3-yl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)  
piperazine:

20

a) Phenyl N-(2-methylquinolin-3-yl)thiocarbamate:

3-Amino-2-methylquinoline(4g, 25mmol) and phenyl

chlorothionoformate(4.32g, 25mmol) were dissolved in methylene chloride  
and then was stirred at room temperature for 2hours. The mixture

25 solution was concentrated under reduced pressure to remove methylene  
chloride and purified by column chromatography(ethylacetate : hexane =  
1 : 2) to obtain the titled compound.

yield : 78%

$^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  2.77(3H,s), 7.09-7.90(9H,m), 9.14(1H,s)

30

b)

1-[(2-Methylquinolin-3-yl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)  
piperazine:

Phenyl N-(2-methylquinolin-3-yl)thiocarbamate(147mg, 0.5mmol) and

35 1-(3,5-dimethoxyphenyl)piperazine(112mg, 0.5mmol) were dissolved in  
anhydrous tetrahydrofuran and DBU(117mg, 0.75mmol) was added and

then the mixture was stirred at room temperature for 2 hrs. The above solution was concentrated under the reduced pressure to remove tetrahydrofuran and purified by column chromatography(ethylacetate : hexane = 1 : 2) to obtain the titled compound.

5 yield : 86%

m.p. : 211-212°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.81(3H,s), 3.35(4H,t), 3.79(6H,s), 4.14(4H,t),  
6.07(3H,s), 7.49(2H,t), 7.68(2H,m), 8.01(1H,s), 8.07(1H,d)

10 Example 126

1-[(2-Methylquinolin-3-yl)aminothiocarbonyl]-4-(3,5-dimethylphenyl)  
piperazine:

Phenyl N-(2-methylquinolin-3-yl)thiocarbamate and

1-(3,5-dimethylphenyl)piperazine were reacted by the same way with

15 the example 125 to obtain the titled compound.

yield : 81%

m.p. : 196-197°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.27(6H,s), 2.81(3H,s), 3.31(4H,t), 4.11(4H,t),  
6.53(2H,s), 6.58(1H,s), 7.48(2H,t), 7.67(2H,m), 7.96(1H,s), 8.04(1H,d)

20

Example 127

1-[(2-Methylquinolin-3-yl)aminothiocarbonyl]-4-(3,5-difluorophenyl)  
piperazine:

Phenyl N-(2-methylquinolin-3-yl)thiocarbamate and

25 1-(3,5-difluorophenyl)piperazine were reacted by the same way with the  
example 125 to obtain the titled compound.

yield : 74%

m.p. : 211-213°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.85(3H,s), 3.43(4H,t), 4.22(4H,t), 6.33(2H,m),  
30 7.49(1H,t), 7.64(1H,d), 7.72(1H,t), 8.16(2H,m)

Example 128

1-[(2-(Pyridin-2-yl)quinolin-4-yl)aminocarbonyl]-4-(3,5-  
dimethoxyphenyl)piperazine:

35 Phenyl N-[2-(pyridin-3-yl)quinolin-4-yl]carbamate(171mg, 0.5mmol) and  
1-(3,5-dimethoxyphenyl)piperazine(111mg, 0.5mmol) were dissolved in

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anhydrous tetrahydrofuran and DBU(117mg, 0.75mmol) was added and then the mixture was stirred at room temperature for 2hrs. The above solution was concentrated under the reduced pressure to remove tetrahydrofuran and purified by column chromatography (dichloromethane : methanol=20:1) to obtain the titled compound.  
yield : 73%  
m.p. : 97-98°C  
<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.34(4H,t), 3.79(6H,s), 3.90(4H,t), 6.07(1H,s), 6.12(2H,s), 7.43(1H,t), 7.50(1H,t), 7.68(1H,t), 7.93(1H,t), 8.26(1H,d), 8.59(1H,d), 8.80(1H,d), 8.98(1H,s)  
Mass(EI) m/z : Calcd for C<sub>31</sub>H<sub>27</sub>N<sub>5</sub>O<sub>3</sub> 517.2113, found 517.3244

## Example 129

1-([2-(Pyridin-3-yl)quinolin-4-yl]aminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine:  
Phenyl N-[2-pyridin-3-yl]quinolin-4-yl]carbamate(171mg, 0.5mmol) and 1-(3,5-dimethoxyphenyl)piperazine(111mg, 0.5mmol) were dissolved in anhydrous tetrahydrofuran and DBU(117mg, 0.75mmol) was added and then the mixture was stirred at room temperature for 2 hours. The above solution was concentrated under the reduced pressure to remove tetrahydrofuran and purified by column chromatography (dichloromethane : methanol = 20:1) to obtain the titled compound.  
yield : 67%  
m.p. : 95-96°C  
<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.36(4H,t), 3.87(6H,s), 3.90(4H,t), 6.08(1H,s), 6.12(2H,s), 7.50(1H,t), 7.71(1H,t), 7.93(1H,t), 8.25(1H,d), 8.53(1H,d), 8.67(1H,s), 8.73(1H,d), 9.35(1H,s)

## Example 130

1-([2-Thien-2-yl]quinolin-4-yl]aminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine:  
Phenyl N-[2-(thien-2-yl)quinolin-4-yl]carbamate(173mg, 0.5mmol) and 1-(3,5-dimethoxyphenyl)piperazine(111mg, 0.5mmol) were dissolved in anhydrous tetrahydrofuran and DBU(117mg, 0.75mmol) was added. The resulting mixture was stirred at room temperature for 2 hours, concentrated under the reduced pressure to remove tetrahydrofuran and



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purified by column chromatography(ethylacetate : hexane = 1:1) to obtain the titled compound.

yield : 61%

m.p. : oil phase

- 5 <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.37(4H,t), 3.59(6H,s), 3.97(4H,t), 7.01(3H,m), 7.49(1H,t), 7.69(1H,t), 7.93(1H,t), 8.20(1H,d), 8.52(1H,d), 8.64(1H,s), 8.71(1H,d), 9.35(1H,s)

Example 131

- 10 1-([2-(Pyridin-3-yl)quinolin-4-yl]aminocarbonyl)-4-(3,5-dimethylphenyl) piperazine:

- Phenyl N-[2-(pyridin-3-yl)quinolin-4-yl]carbamate(171mg, 0.5mmol) and 1-(3,5-dimethylphenyl)piperazine(95mg, 0.5mmol) were dissolved in anhydrous tetrahydrofuran and DBU(117mg, 0.75mmol) was added. The  
15 resulting mixture was stirred at room temperature for 2 hours, concentrated under the reduced pressure to remove tetrahydrofuran, and purified by column chromatography(ethylacetate : hexane =1:1) to obtain the titled compound.

yield : 64%

- 20 m.p. : 211-213°C

<sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.31(6H,s), 3.32(4H,t), 3.85(4H,t), 6.61(3H,s), 7.47(1H,t), 7.55(1H,t), 7.72(1H,t), 7.86(1H,t), 8.25(1H,d), 8.53(1H,d), 8.66(1H,s), 8.72(1H,d), 9.37(1H,s)

- 25 Example 132

- 1-[N-(5,6-Dimethyl-2-methoxypyridin-3-yl)-N-methylaminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

- 1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine(100mg, 0.25mmol) was dissolved in  
30 dimethylformamide(15ml) and thereto sodium hydride(6.0mg, 0.25mmol) was added. The resulting mixture was stirred at room temperature for 15 min and thereto iodomethane(35mg, 0.25mmol) was added. The resulting mixture was stirred at room temperature for 16 hrs, concentrated under the reduced presssure to remove dimethylformamide,  
35 and purified by column chromatography(ethylacetate : hexane=1:2) to obtain the titled compound.

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yield : 94%

m.p. : oil phase

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 2.17(3H,s), 2.38(3H,s), 2.92(4H,t), 3.04(3H,s),  
3.29(4H,t), 3.74(6H,s), 3.96(3H,s), 6.00(3H,m), 7.08(1H,s)

5

#### Example 133

1-[N-Ethyl-N-(5,6-dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine(100mg, 0.25mmol) was dissolved in  
10 dimethylformamide(15ml) and thereto sodium hydride(6.0mg, 0.25mmol)  
was added, followed by stirring at room temperature for 15 min and  
then iodoethane(39.2mg, 0.25mmol) was added. The resulting mixture  
was stirred at room temperature for 16 hrs, concentrated under the  
15 reduced pressure to remove dimethylformamide, and purified by column  
chromatography(ethylacetate : hexane=1:2) to obtain the titled compound.  
yield : 86%

m.p. : oil phase

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 1.08(3H,t), 2.04(3H,s), 2.38(3H,s), 2.90(4H,t),  
20 3.26(4H,t), 3.52(2H,q), 3.74(6H,s), 5.99(3H,m), 7.06(1H,s)

#### Example 134

1-[N-Isopropyl-N-(5,6-dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine(100mg, 0.25mmol) was dissolved in  
25 dimethylformamide(15ml) and thereto sodium hydride(6.0mg, 0.25mmol)  
was added, followed by stirring at room temperature for 15 min, and  
then 2-iodopropane(42mg, 0.25mmol) was added. The resulting mixture  
30 was stirred at room temperature for 16 hrs, concentrated under the  
reduced pressure to remove dimethylformamide, purified by column  
chromatography(ethylacetate : hexane=1:2) to obtain the titled compound.  
yield : 78%

m.p. : oil phase

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 1.13(6H,d), 2.19(3H,s), 2.38(3H,s), 2.82(4H,t),  
35 3.26(4H,t), 3.74(6H,s), 3.89(3H,s), 4.27(1H,m), 6.06(1H,s), 6.10(2H,d),

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7.07(1H,s), 8.14(1H,s)

Mass(EI) m/z : Calcd for  $C_{24}H_{34}N_4O_4$  442.2580, found 442.2538

## Example 135

5 1-[N-(5,6-Dimethyl-2-methoxypyridin-3-yl)-N-methylaminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 132 to obtain the titled compound.

10 yield : 97%

m.p. : oil phase

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 2.15(6H,s), 2.23(3H,s), 2.37(3H,s), 2.89(4H,t), 3.04(3H,s), 3.30(4H,t), 3.97(3H,s), 6.46(3H,m), 7.08(1H,s)

15 Example 136

1-[N-(5,6-Dimethyl-2-methoxypyridin-3-yl)-N-methylaminocarbonyl]-4-(2-methoxyphenyl)piperazine:

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)piperazine was reacted by the same way with the example 132 to

20 obtain the titled compound.

yield : 94%

m.p. : 131-132°C

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 2.16(3H,s), 2.38(3H,s), 2.80(4H,t), 3.05(3H,s), 3.35(4H,t), 3.82(3H,s), 3.97(3H,s), 6.83(4H,m), 7.08(1H,s)

25

## Example 137

1-[N-Ethyl-N-(5,6-dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)piperazine:

30 1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)piperazine was reacted by the same way with the example 133 to obtain the titled compound.

yield : 87%

m.p. : 112-113°C

35  $^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 1.08(3H,t), 2.16(3H,s), 2.38(3H,s), 2.77(4H,t), 3.31(4H,t), 3.58(2H,q), 3.81(3H,s), 3.96(3H,s), 6.88(4H,m), 7.06(1H,s)

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## Example 138

1-[N-Benzyl-N-(5,6-dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)piperazine:

- 1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)piperazine(100mg, 0.27mmol) was dissolved in dimethylformamide(15ml) and thereto sodium hydride(6.5mg, 0.27mmol) was added, followed by stirring at room temperature for 1hr, and successively benzyl bromide(46.2mg, 0.27mmol) was added. The resulting mixture was stirred at room temperature for 16 hrs, concentrated under the reduced pressure and purified by column chromatography(ethylacetate : hexane = 1: 2) to obtain the titled compound.

yield : 93%

m.p. : oil phase

- <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 2.08(3H,s), 2.35(3H,s), 2.85(4H,t), 3.32(4H,t), 3.81(3H,s), 3.96(3H,s), 4.76(2H,s), 6.96(4H,m), 7.41(5H,m)

## Example 139

1-[N-Cyclopropylmethyl-N-(5,6-dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)piperazine:

- 1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(2-methoxyphenyl)piperazine(100mg, 0.26mmol) was dissolved in dimethylformamide(15ml) and thereto sodium hydride(6.2mg, 0.26mmol) was added, followed by stirring at room temperature for 15 min, and successively bromomethylcyclopropane(21.8mg, 0.26mmol) was added. The resulting mixture was stirred at room temperature for 16 hrs, concentrated under the reduced pressure and purified by column chromatography(ethylacetate : hexane = 1: 2) to obtain the titled compound.

- yield : 78%

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 0.34(2H,m), 0.49(2H,m), 1.35(1H,m), 2.85(4H,t), 3.28(4H,t), 3.40(2H,s), 3.89(3H,s), 3.97(3H,s), 6.97(4H,m), 7.11(1H,s)

## 35 Example 140

1-[N-(5,6-Dimethyl-2-methoxypyridin-3-yl)-N-methylaminocarbonyl]-4-

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(5-methoxy-2-methylphenyl)piperazine:

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(5-methoxy-2-methylphenyl)piperazine was reacted by the same way with the example 132 to obtain the titled compound.

5 yield : 74%

m.p. : 91-93°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.15(3H,s), 2.18(3H,s), 2.39(3H,s), 2.67(4H,t), 3.05(3H,s), 3.30(4H,t), 3.75(3H,s), 3.97(3H,s), 6.48(3H,m), 7.10(1H,s)

10 Example 141

1-[N-Ethyl-N-(5,6-dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(5-methoxy-2-methylphenyl)piperazine:

1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(5-methoxy-2-methylphenyl)piperazine was reacted by the same way with the

15 example 133 to obtain the titled compound.

yield : 94%

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.09(3H,t), 2.15(3H,s), 2.18(3H,s), 2.39(3H,s), 2.60(4H,t), 3.27(4H,t), 3.59(2H,q), 3.75(3H,s), 3.96(3H,s), 6.45(3H,m),

20 7.08(1H,s)

Example 142

1-[N-Benzyl-N-(5,6-dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(5-methoxy-2-methylphenyl)piperazine:

25 1-[(5,6-Dimethyl-2-methoxypyridin-3-yl)aminocarbonyl]-4-(5-methoxy-2-methylphenyl)piperazine was reacted by the same way with the example 138 to obtain the titled compound.

yield : 97%

m.p. : oil phase

30 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.25(3H,t), 2.08(3H,s), 2.14(3H,s), 2.35(3H,s), 2.60(4H,t), 3.32(4H,t), 3.74(3H,s), 3.95(3H,s), 4.66(2H,s), 6.44(4H,m), 6.96(5H,m), 7.12(1H,s)

Example 143

35 1-[N-(5-Ethyl-2-methoxy-6-methylpyridin-3-yl)-N-methylamino carbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

1-[(5-Ethyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the example 132 to obtain the titled compound.

yield : 87%

5 m.p. : 78-79°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.14(3H,t), 2.41(3H,s), 2.52(2H,q), 2.91(4H,t), 3.02(3H,s), 3.28(4H,t), 3.74(6H,s), 3.98(3H,s), 5.98(3H,m), 7.11(1H,s)

Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>32</sub>N<sub>4</sub>O<sub>4</sub> 428.2423, found 428.2434

10 Example 144

1-[N-(5-Ethyl-2-methoxy-6-methylpyridin-3-yl)-N-methylamino carbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(5-Ethyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the

15 example 132 to obtain the titled compound.

yield : 84%

m.p. : 86-87°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.14(3H,t), 2.23(6H,s), 2.45(3H,s), 2.58(2H,q), 2.87(4H,t), 3.05(3H,s), 3.30(4H,t), 3.98(3H,s), 6.46(3H,m), 7.11(1H,s)

20 Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>32</sub>N<sub>4</sub>O<sub>2</sub> 396.2525, found 396.2575

Example 145

1-[N-Ethyl-N-(5-ethyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

25 1-[(5-Ethyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 133 to obtain the titled compound.

yield : 86%

m.p. : 84-85°C

30 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.13(6H,m), 2.23(6H,s), 2.41(3H,s), 2.58(2H,q), 2.85(4H,t), 3.26(4H,t), 3.46(2H,q), 3.96(3H,s), 6.45(3H,m), 7.08(1H,s)

Example 146

1-[N-(2-Methoxy-6-methyl-5-propylpyridin-3-yl)-N-methylamino carbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

35

1-[(2-Methoxy-6-methyl-5-propylpyridin-3-yl)aminocarbonyl]-4-

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(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 132 to obtain the titled compound.

yield : 89%

m.p. : oil phase

- 5  $^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 1.01(3H,t), 1.78(2H,m), 2.21(3H,s), 2.78(2H,t), 3.78(6H,s), 3.86(4H,t), 3.99(3H,s), 4.00(3H,s), 4.22(4H,t), 6.01(3H,m), 7.02(1H,s)

Example 147

- 10 1-[N-(6-Ethyl-2-methoxy-5-methylpyridin-3-yl)-N-methylamino carbonyl]-4-(3,5-dimethoxyphenyl)piperazine:  
1-[(6-Ethyl-2-methoxy-5-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the example 132 to obtain the titled compound.

- 15 yield : 85%

m.p. : oil phase

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 2.21(3H,t), 2.21(3H,s), 2.45(2H,q), 3.21(4H,t), 3.40(3H,s), 3.67(4H,t), 3.77(6H,s), 4.01(3H,s), 6.07(3H,m), 6.96(1H,s), 8.07(1H,s)

20

Example 148

1-[N-(2-Methoxy-5-methyl-6-propylpyridin-3-yl)-N-methylamino carbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

- 25 1-[(2-Methoxy-5-methyl-6-propylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the example 132 to obtain the titled compound.

yield : 86%

m.p. : 106-107°C

- 30  $^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 0.98(3H,t), 1.73(2H,q), 2.18(3H,s), 2.63(2H,t), 2.92(4H,t), 3.05(3H,s), 3.29(4H,t), 3.74(6H,s), 3.96(3H,s), 6.00(3H,m), 7.11(1H,s)

Mass(EI)  $m/z$  : Calcd for  $\text{C}_{24}\text{H}_{34}\text{N}_4\text{O}_4$  442.2580, found 442.2543

Example 149

- 35 1-[N-(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)-N-methylamino carbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

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1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 132 to obtain the titled compound.

yield : 89%

5 m.p. : oil phase

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 2.50(3H,s), 2.70(3H,s), 2.97(4H,t), 3.09(3H,s), 3.33(4H,t), 3.75(6H,s), 4.06(3H,s), 6.03(3H,m), 7.72(1H,s)

Mass(EI) m/z : Calcd for  $\text{C}_{23}\text{H}_{30}\text{N}_4\text{O}_5$  442.2216, 442.2229

10 Example 150

1-[N-Ethyl-N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the

15 example 133 to obtain the titled compound.

yield : 87%

m.p. : oil phase

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 1.09(3H,t), 2.49(3H,s), 2.70(3H,s), 3.00(4H,t), 3.32(4H,t), 3.77(6H,s), 4.01(3H,s), 4.09(2H,q), 5.98(3H,m), 7.76(1H,s)

20

Example 151

1-[N-(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)-N-methylamino carbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same with the example 132 to obtain the titled compound.

25 yield : 88%

m.p. : oil phase

$^1\text{H}$  NMR( $\text{CDCl}_3$ )  $\delta$  : 2.24(6H,s), 2.50(3H,s), 2.70(3H,s), 2.93(4H,t), 3.09(3H,s), 3.28(4H,t), 4.06(3H,s), 6.46(3H,m), 7.73(1H,s)

30

Example 152

1-[N-[5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]-N-methyl aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

35 1-[N-(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)-N-methylamino carbonyl]-4-(3,5-dimethoxyphenyl)piperazine(0.47mmol) was dissolved in



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anhydrous ethanol(15ml) and thereto sodium borohydride(17.3mg) was added, then followed by stirring at room temperature for 2 hrs. The resulting mixture was concentrated under the reduced pressure to remove ethanol and purified by column chromatography(ethylacetate :

5 hexane = 2:1) to obtain the titled compound.

yield : 97%

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.14(3H,d), 2.44(3H,s), 2.93(4H,t), 3.06(3H,s), 3.30(4H,t), 3.74(6H,s), 3.98(3H,s), 5.03(1H,q), 6.02(3H,m), 7.50(1H,s)

10

#### Example 153

1-(N-Ethyl-N-[5-(1-hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl] aminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine;

15 1-[N-Ethyl-N-(5-cetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the example 152 to obtain the titled compound.

yield : 96%

m.p. : oil phase

20 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.09(3H,t), 1.41(3H,d), 2.44(3H,s), 2.91(4H,t), 3.27(4H,t), 3.54(1H,q), 3.74(6H,s), 3.96(3H,s), 5.03(1H,q), 6.02(3H,m), 8.46(1H,s)

#### Example 154

25 1-[N-[5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]-N-methylaminocarbonyl]-4-(3,5-dimethylphenyl)piperazine;

1-[N-Methyl-N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)amino carbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 152 to obtain the titled compound.

yield : 97%

30 m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.41(3H,d), 2.24(6H,s), 2.44(3H,s), 2.91(4H,t), 3.06(3H,s), 3.26(4H,t), 3.99(3H,s), 5.03(1H,q), 6.49(3H,m), 7.50(1H,s)

#### Example 155

35 1-(N-[5-(1-Hydroxy-1-methylethyl)-2-methoxy-6-methylpyridin-3-yl]-N-methylaminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine;

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1-[N-Methyl-N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)amino carbonyl]-4-(3,5-dimethoxyphenyl)piperazine(221mg, 0.5mmol) was dissolved in tetrahydrofuran(10ml) and thereto methyl magnesium bromide(0.50ml, 1.50mmol). The resulting mixture was refluxed for 15  
5 hrs, concentrated under the reduced pressure to remove used solvent, extracted with ethylacetate, filtered to dryness, and purified by column chromatography(ethylacetate : hexane =1:2) to obtain the titled compound.  
yield : 92%

10 m.p. : oil phase  
<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.59(6H,s), 2.66(3H,s), 2.93(4H,t), 3.06(3H,s), 3.30(4H,t), 3.74(6H,s), 3.99(3H,s), 6.03(3H,m), 7.45(1H,s)

#### Example 156

15 1-{N-[5-(1-Hydroxy-1-methylpropyl)-2-methoxy-6-methylpyridin-3-yl]-N-methylaminocarbonyl}-4-(3,5-dimethylphenyl)piperazine:  
1-[N-Methyl-N-(5-acetyl-2-methoxy-6-methylpyridin-3-yl)amino carbonyl]-4-(3,5-dimethylphenyl)piperazine(213mg, 0.5mmol) was dissolved in tetrahydrofuran(10ml) and thereto methyl magnesium  
20 bromide(0.50ml, 1.50mmol) was added slowly, then refluxed for 15 hrs. The resulting mixture was concentrated under the reduced pressure to remove the used solvent, extracted with ethylacetate, filtered to dryness, and purified by column chromatography(ethylacetate : hexane =1:2) to obtain the titled compound.  
25 yield : 88%  
m.p. : oil phase  
<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 0.79(3H,t), 1.58(3H,s), 1.85(2H,q), 2.61(3H,s), 2.99(4H,t), 3.07(3H,s), 3.30(4H,t), 3.76(6H,s), 6.12(3H,m), 7.47(1H,s)

#### 30 Example 157

1-{N-[2-Methoxy-5-(1-methoxyethyl)-6-methylpyridin-3-yl]-N-methyl aminocarbonyl}-4-(3,5-dimethoxyphenyl)piperazine:  
1-{N-[5-(1-Hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]amino carbonyl}-4-(3,5-dimethoxyphenyl)piperazine was reacted by the same  
35 way with the example 132 to obtain the titled compound.  
yield : 95%

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m.p. : 117-119°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.34(3H,t), 2.43(3H,s), 2.94(4H,t), 3.06(3H,s),  
3.18(3H,s), 3.30(4H,t), 3.74(6H,s), 3.99(3H,s), 4.44(1H,q), 6.02(3H,m),  
7.37(1H,s)

5

Example 158

1-[N-(2-Methoxy-6-methyl-5-vinylpyridin-3-yl)-N-methylamino  
carbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

10 1-[(2-Methoxy-6-methyl-5-vinylpyridin-3-yl)aminocarbonyl]-4-  
(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the  
example 132 to obtain the titled compound.

yield : 94%

m.p. : oil phase

15 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.46(3H,s), 2.93(4H,t), 3.07(3H,s), 3.30(4H,t),  
3.73(6H,s), 3.99(3H,s), 5.25(1H,d), 5.48(1H,d), 6.01(3H,m), 6.78(1H,s),  
7.43(1H,s)

Example 159

20 1-[N-(2-Methoxy-6-methyl-5-vinylpyridin-3-yl)-N-methylamino  
carbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(2-Methoxy-6-methyl-5-vinylpyridin-3-yl)aminocarbonyl]-4-  
(3,5-dimethylphenyl)piperazine was reacted by the same way with the  
example 132 to obtain the titled compound.

yield : 89%

25 m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 2.24(6H,s), 2.43(3H,s), 2.90(4H,t), 3.04(3H,s),  
3.27(4H,t), 3.99(3H,s), 5.23(1H,d), 5.45(1H,d), 6.05(3H,m), 6.77(1H,s),  
7.40(1H,s)

30 Example 160

1-[N-Ethyl-N-(2-methoxy-6-methyl-5-vinylpyridin-3-yl)aminocarbonyl]  
-4-(3,5-dimethoxyphenyl)piperazine:

1-[(2-Methoxy-6-methyl-5-vinylpyridin-3-yl)aminocarbonyl]-4-  
(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the  
35 example 133 to obtain the titled compound.

yield : 92%

- 78 -

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.09(3H,t), 2.43(3H,s), 2.94(4H,t), 3.28(4H,t),  
3.77(6H,s), 4.01(3H,s), 4.11(2H,q), 5.25(1H,d), 5.49(1H,d), 5.98(3H,m),  
6.77(1H,s), 7.44(1H,s)

5

Example 161

1-[N-(5-Isopropenyl-2-methoxy-6-methylpyridin-3-yl)-N-methylamino  
carbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

10 1-[(5-Isopropenyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-  
(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the  
example 132 to obtain the titled compound.

yield : 92%

m.p. : oil phase

15 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.98(3H,s), 2.43(3H,s), 2.92(4H,t), 3.06(3H,s),  
3.29(4H,t), 3.74(6H,s), 3.99(3H,s), 4.84(1H,s), 5.30(1H,s), 6.01(3H,m),  
7.10(1H,s)

Example 162

20 1-[N-(5-Isopropenyl-2-methoxy-6-methylpyridin-3-yl)-N-methylamino  
carbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(5-Isopropenyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-  
(3,5-dimethylphenyl)piperazine was reacted by the same way with the  
example 132 to obtain the titled compound.

yield : 91%

25 m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.98(3H,s), 2.24(6H,s), 2.43(3H,s), 2.90(4H,t),  
3.06(3H,s), 3.28(4H,t), 4.00(3H,s), 4.84(1H,s), 5.19(1H,s), 6.46(3H,m),  
7.10(1H,s)

30 Example 163

Ethyl 2-([(4-(3,5-dimethoxyphenyl)piperazino]carbonyl)(5-acetyl-2-  
methoxy-6-methylpyridin-3-yl)amino)acetate:

1-[(5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-  
(3,5-dimethoxyphenyl)piperazine(200mg, 0.5mmol) was dissolved in  
35 dimethylformamide(15ml) and thereto sodium hydride(18.5mg, 0.5mmol)  
was added, then followed by stirring at room temperature for 15 min.

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and ethylbromoacetate(83.5mg, 0.5mmol) was added. The resulting mixture was stirred at room temperature for 3 hrs, concentrated under the reduced pressure to remove the used solvent, and purified by column chromatography(ethylacetate : hexane =1:2) to obtain the titled compound.

yield : 84%

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.26(3H,t), 2.51(3H,s), 2.69(3H,s), 3.04(4H,t), 3.43(4H,t), 3.75(6H,s), 4.05(3H,s), 4.15(2H,q), 4.19(2H,s), 6.08(3H,s), 7.96(1H,s)

#### Example 164

Ethyl 2-(((4-(3,5-dimethylphenyl)piperazino)carbonyl)(5-acetyl-2-methoxy-6-methylpyridin-3-yl)amino)acetate:

1-[([5-Acetyl-2-methoxy-6-methylpyridin-3-yl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 163 to obtain the titled compound.

yield : 80%

m.p. : oil phase

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.25(3H,t), 2.56(3H,s), 2.69(3H,s), 3.00(4H,t), 3.29(4H,t), 3.78(6H,s), 4.06(3H,s), 4.18(2H,s), 5.99(3H,m), 7.98(1H,s)

#### Example 165

2-(((4-(3,5-Dimethoxyphenyl)piperazino)carbonyl)(5-acetyl-2-methoxy-6-methylpyridin-3-yl)amino)acetic acid:

Ethyl ([4-(3,5-dimethoxyphenyl)piperazino]carbonyl)(5-acetyl-2-methoxy-6-methylpyridin-3-yl)amino)acetate(200mg, 0.38mmol) was dissolved in mixed solvent of dioxane : distilled water =4:1(15ml), and lithium hydroxide hydrate(48.1mg, 1.14mmol) was added, then followed by stirring at room temperature for 3 hrs. The resulting mixture was made acidic with 1N-HCl, extracted with ethylacetate, filtered to dryness, concentrated under the reduced pressure and purified by column chromatography(ethylacetate : hexane = 1 : 2) to obtain the titled compound.

yield : 94%

m.p. : 135-137°C

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<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 2.52(3H,s), 2.69(3H,s), 3.11(4H,t), 3.49(4H,t), 3.74(6H,s), 4.05(3H,s), 4.24(2H,s), 6.15(3H,m), 7.83(1H,s)

## Example 166

- 5 Ethyl 2-([4-(3,5-dimethoxyphenyl)piperazino]carbonyl)[5-(1-hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]amino)acetate:  
Ethyl 2-([4-(3,5-dimethoxyphenyl)piperazino]carbonyl)(5-acetyl-2-methoxy-6-methylpyridin-3-yl)amino)acetate was reacted by the same way with the example 152 to obtain the titled compound.

10 yield : 97%

m.p. : 125-127°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 1.26(3H,t), 1.42(3H,d), 2.44(3H,s), 3.04(4H,t), 3.31(4H,t), 3.75(6H,s), 3.97(3H,s), 4.16(2H,q), 4.19(2H,s), 6.15(3H,m), 7.69(1H,s)

15

## Example 167

- Ethyl 2-([4-(3,5-dimethoxyphenyl)piperazino]carbonyl)[5-(1-hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]amino)acetate:  
Ethyl 2-([4-(3,5-dimethoxyphenyl)piperazino]carbonyl)[5-(1-hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]amino)acetate was reacted by the same way with the example 164 to obtain the titled compound.

yield : 92%

m.p. : oil phase

- 25 <sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 1.41(3H,d), 2.44(3H,s), 2.98(4H,t), 3.36(4H,t), 3.74(6H,s), 3.98(3H,s), 4.40(2H,s), 5.00(1H,q), 6.08(3H,m), 7.69(1H,s)

## Example 168

- Ethyl 2-([4-(3,5-dimethylphenyl)piperazino]carbonyl)[5-(1-hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]amino)acetate:  
Ethyl 2-([4-(3,5-dimethylphenyl)piperazino]carbonyl)(5-acetyl-2-methoxy-6-methylpyridin-3-yl)amino)acetate was reacted by the same way with the example 152 to obtain the titled compound.

yield : 94%

- 35 m.p. : 68-70°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ: 1.13(3H,t), 1.47(3H,d), 2.33(6H,s), 2.44(3H,s),

- 81 -

2.95(4H,t), 3.30(4H,t), 3.98(3H,s), 4.10(2H,q), 5.01(1H,q), 6.46(3H,m),  
7.71(1H,s)

## Example 169

5 2-(((4-(3,5-Dimethylphenyl)piperazino]carbonyl)[5-(1-hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]amino)acetic acid:

Ethyl 2-(((4-(3,5-dimethylphenyl)piperazino]carbonyl)[5-(1-hydroxyethyl)-2-methoxy-6-methylpyridin-3-yl]amino)acetate was  
reacted by the same way with the example 165 to obtain the titled

10 compound.

yield : 92%

m.p. : 114-116°C

<sup>1</sup>H NMR(CDCl<sub>3</sub>) δ : 1.40(3H,d), 2.23(6H,s), 2.40(3H,s), 2.91(4H,t),  
3.21(4H,t), 3.98(3H,s), 4.06(2H,s), 4.90(1H,q), 6.50(3H,m), 6.51(1H,s)

15

## Example 170

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-phenylpiperazine  
a) 3,4-Dimethyl anisole:

To 3,4-dimethylphenol(19.3g, 0.16mol), methanol(150ml) and KOH(9.65g,  
20 0.25mol) were added and then refluxed for 2hrs. Methyl iodide(36.5g,  
0.25mol) was added thereto, refluxed for 3 hours and then followed by  
addition of water(150ml). The resulting mixture was extracted with  
ethylacetate and purified by column chromatography to obtain the  
titled compound.

25 yield : 81%

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.24(3H,s), 3.77(3H,s),  
6.71(2H,m), 6.97(1H,s)

b) 4,5-Dimethyl-2-nitroanisole:

Trifluoroacetic acid(250ml) was added into 3,4-dimethylanisole(17.1g,  
30 0.13mol), successively sodium nitrite(16.6g, 0.24mol) was added slowly  
in water bath, and stirred at room temperature for 14 hrs. After  
trifluoroacetic acid was removed and water was added thereto, the  
resulting mixture was extracted with ether, and purified by column  
chromatography to obtain the titled compound.

35 yield : 55%

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.25(3H,s), 2.32(3H,s), 3.94(3H,s),

- 82 -

6.85(1H,s), 7.70(1H,s)

c) 4,5-Dimethyl-2-methoxyaniline:

Tetrahydrofuran(100ml) and ethanol(40ml) were added into  
4,5-dimethyl-2-nitroanisole(7.80g, 0.043mol) and then added 10%

- 5 Pd/activated carbon(0.57g) slowly, hydrogenated for 5 hrs. The reaction  
was completed by the same way with the above and the resulting  
product was purified by column chromatography to obtain the titled  
compound.

yield : 82%

- 10 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.23(3H,s), 2.27(3H,s), 3.90(3H,s),  
6.80(1H,s), 7.68(1H,s)

d) Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate:

- To 4,5-dimethyl-2-methoxyaniline(4.50g, 0.03mol), methylene  
chloride(100ml) was added and phenyl chloroformate(4.80g, 0.03mol) was  
15 added slowly. The resulting solution was stirred for 2 hrs and thereto  
water(150ml) was added, and extracted with methylene chloride and  
purified by column chromatography to obtain the titled compound.

yield : 98%

- <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.24(3H,s), 2.27(3H,s), 3.89(3H,s),  
20 6.85(1H,s), 7.20(5H,m), 7.90(1H,s)

e) 1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-phenylpiperazine:

- Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate(5.422g, 0.02mol) and  
1-phenylpiperazine(3.44g, 0.02mol) were dissolved in  
tetrahydrofuran(10ml). After DBU(3.04g, 0.02mol) was added, the  
25 resulting solution was stirred at room temperature for 2 hrs,  
concentrated and purified by column chromatography to obtain the  
titled compound.

yield : 85%

m.p.: 143-144°C

- 30 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.21(3H,s), 3.25(4H,t), 3.67(4H,t),  
3.85(3H,s), 6.64(1H,s), 6.94(3H,m), 6.99(1H,s), 7.29(1H,t), 7.91(1H,s)

## Example 171

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-

- 35 (3,5-dimethoxyphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and



1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

yield : 85%

m.p. : 119-120°C

- 5 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.21(3H,s), 3.27(4H,t), 3.70(4H,t), 3.79(6H,s), 3.85(3H,s), 6.17(2H,m), 6.65(1H,s), 6.98(1H,s), 7.90(1H,s)  
Mass(EI) m/z : Calcd for C<sub>22</sub>H<sub>29</sub>N<sub>3</sub>O<sub>4</sub> 399.2158, found 399.2168

#### Example 172

- 10 1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

- 15 yield : 88%

m.p. : 177-178°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.21(3H,s), 2.29(6H,s), 3.23(4H,t), 3.66(4H,t), 3.85(3H,s), 6.58(2H,m), 6.65(1H,s), 6.99(1H,s), 7.92(1H,s)

- 20 Mass(EI) m/z : Calcd for C<sub>22</sub>H<sub>29</sub>N<sub>3</sub>O<sub>2</sub> 367.2259, found 367.2290

#### Example 173

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(2,3-dimethylphenyl)piperazine:

- 25 Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and 1-(2,3-dimethylphenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

yield : 95%

m.p. : 140-142°C

- 30 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.21(3H,s), 2.22(3H,s), 2.27(3H,s), 2.29(3H,s), 2.95(4H,t), 3.67(4H,t), 3.85(3H,s), 6.65(1H,s), 7.01(3H,m), 7.93(1H,s)

#### Example 174

- 35 1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(2,3,5,6-tetramethylphenyl)piperazine:

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Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and 1-(2,3,5,6-tetramethylphenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.  
yield : 93%

- 5 m.p. : oil phase  
<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(9H,s), 2.21(9H,s), 3.17(4H,t), 3.63(4H,t), 3.84(3H,s), 6.64(1H,s), 6.84(1H,s), 7.95(1H,s)

Example 175

- 10 1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-difluorophenyl) piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and 1-(3,5-difluorophenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

- 15 yield : 89%  
m.p. : 102-103°C  
<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.22(3H,s), 3.29(4H,t), 3.68(4H,t), 3.85(3H,s), 6.65(1H,s), 6.97(3H,m), 7.89(1H,s)

20 Example 176

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(2-chlorophenyl) piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and 1-(2-chlorophenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

- 25 yield : 90%  
m.p. : 176-177°C  
<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.21(3H,s), 2.22(3H,s), 3.10(4H,t,J=5.0Hz), 3.69(4H,t,J=5.0Hz), 3.85(3H,s), 6.65(1H,s), 7.02(2H,m), 7.24(1H,m),  
30 7.39(1H,d,J=4.0Hz), 7.92(1H,s)

Example 177

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3-chlorophenyl) piperazine:

- 35 Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and 1-(3-chlorophenyl)piperazine were reacted by the same way with the

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example 170 to obtain the titled compound.

yield : 84%

m.p. : 75-76°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.22(3H,s), 3.27(4H,t,J=5.0Hz),

5 3.68(4H,t,J=5.0Hz), 3.85(3H,s), 6.65(1H,s), 6.90(3H,m), 7.21(1H,t),  
7.90(1H,s)

Mass(EI) m/z : Calcd for C<sub>20</sub>H<sub>24</sub>N<sub>3</sub>O<sub>2</sub>Cl 373.1557, found 373.1590

#### Example 178

10 1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(2-hydroxyphenyl)  
piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

1-(2-hydroxyphenyl)piperazine were reacted by the same way with the  
example 170 to obtain the titled compound.

15 yield : 87%

m.p. : 197-199°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.21(3H,s), 2.98(4H,t), 3.72(4H,t),  
3.84(3H,s), 6.65(1H,s), 6.89(1H,t), 7.00(2H,m), 7.13(2H,m), 7.89(1H,s)

#### 20 Example 179

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3-hydroxyphenyl)  
piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

1-(3-hydroxyphenyl) were reacted by the same way with the example

25 170 to obtain the titled compound.

yield : 88%

m.p. : 177-178°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.19(3H,s), 2.21(3H,s), 3.24(4H,t), 3.68(4H,t),  
3.85(3H,s), 6.41(3H,m), 6.65(1H,s), 6.98(1H,s), 7.13(1H,t), 7.88(1H,s)

30

#### Example 180

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3-thiophenyl)  
piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

35 1-(3-thiophenyl)piperazine were reacted by the same way with the  
example 170 to obtain the titled compound.

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yield: 79%

m.p.: 108-110°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.21(3H,s), 3.26(4H,t), 3.65(4H,t), 3.84(3H,s), 6.64(1H,s), 6.97(4H,m), 7.05(1H,s), 7.89(1H,s)

5

Example 181

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(2-acetoxyphenyl)  
piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

10 1-(2-acetoxyphenyl)piperazine were reacted by the same way with the  
example 170 to obtain the titled compound.

yield: 84%

m.p.: 129-131°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.21(3H,s), 2.32(3H,s),  
15 3.05(4H,t), 3.63(4H,t), 3.85(3H,s), 6.64(1H,s), 6.99(1H,s), 7.04(1H,m),  
7.17(2H,m), 7.22(1H,m), 7.90(1H,s)

Example 182

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3-acetoxyphenyl)

20 piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

1-(3-acetoxyphenyl)piperazine were reacted by the same way with the  
example 170 to obtain the titled compound.

yield: 87%

25 m.p.: 154-156°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.21(3H,s), 2.29(3H,s),  
3.27(4H,t), 3.68(4H,t), 3.85(3H,s), 6.64(1H,s), 6.66(2H,m), 6.82(1H,m),  
6.98(1H,s), 7.90(1H,s)

30 Example 183

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(2-methoxyphenyl)  
piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

1-(2-methoxyphenyl)piperazine were reacted by the same way with the  
35 example 170 to obtain the titled compound.

yield: 90%

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m.p.: 144-145°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.22(3H,s), 2.26(3H,s), 2.95(4H,t, J=5.0Hz), 3.65(4H,t,J=5.0Hz), 3.78(3H,s), 3.85(3H,s), 6.59(1H,s), 6.65(1H,s), 7.00(1H,s), 7.11(1H,s), 7.93(1H,s)

5

## Example 184

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(5-methoxy-2-methylphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

10 1-(5-methoxy-2-methylphenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

yield: 88%

m.p.: 140-141°C

15 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.22(3H,s), 2.26(3H,s), 2.95(4H,t, J=5.0Hz), 3.65(4H,t,J=5.0Hz), 3.78(3H,s), 3.85(3H,s), 6.59(1H,s), 6.65(1H,s), 7.00(1H,s), 7.11(1H,s), 7.93(1H,s)

## Example 185

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(2-methoxy-5-methylphenyl)piperazine:

20

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

1-(2-methoxy-5-methylphenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

yield: 80%

25 m.p.: 107-108°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.21(3H,s), 2.29(3H,s), 3.10(4H,t, J=5.0Hz), 3.69(4H,t,J=5.0Hz), 3.85(3H,s), 3.86(3H,s), 6.55(1H,s), 6.79(2H,m), 7.01(1H,s), 9.94(1H,s)

## 30 Example 186

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(2-methoxy-5-phenylphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

1-(2-methoxy-5-phenylphenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

35

yield: 91%

- 88 -

m.p.: 139-140°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.21(3H,s), 2.22(3H,s), 3.20(4H,t), 3.74(4H,t), 3.85(3H,s), 3.94(3H,s), 6.65(1H,s), 7.02(2H,m), 7.32(2H,m), 7.42(2H,t), 7.55(2H,d), 7.93(1H,s)

5

Example 187

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(2-isopropenylphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

10 1-(2-isopropenylphenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

yield: 80%

m.p.: 134-135°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.21(6H,s), 3.10(4H,t), 3.64(4H,t),  
15 3.85(3H,s), 5.08(1H,s), 5.14(1H,s), 6.64(1H,s), 7.05(3H,m), 7.70(1H,m), 7.92(1H,s)

Example 188

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(1-naphthyl)  
20 piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

1-(1-naphthyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

yield: 92%

25 m.p.: 160-162°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.24(3H,s), 3.31(4H,t,J=5.0Hz), 3.83(3H,s), 4.04(4H,t), 6.39(2H,m), 6.69(1H,s), 7.13(1H,t), 7.30(1H,s), 7.46(1H,s)

30 Example 189

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(1-anthranyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)carbamate and

1-(1-anthranyl)piperazine were reacted by the same way with the  
35 example 170 to obtain the titled compound.

yield: 94%

m.p.: 74-75°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.22(3H,s), 3.24(4H,t), 3.70(4H,t), 3.86(3H,s), 6.70(1H,s), 7.05(3H,m), 7.45(5H,m), 8.00(2H,m)

5 Example 190

1-[N-(4,5-Dimethyl-2-methoxyphenyl)-N-methylaminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

1-[(4,5-dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine(0.2g, 0.5mmole) was dissolved in

- 10 dimethylformamide(15ml), sodium hydride(12mg, 0.5mmole) was added thereto slowly, and then the resulting mixture was stirred at room temperature for 15 min, then followed by addition of iodomethane(71mg, 0.5mmole) and subsequently at room temperature for 16 hours. The resulting mixture was concentrated under the reduced pressure to
- 15 remove the used solvent, extracted with methylene chloride, dried, filtered and purified by column chromatography to obtain the titled compound.

yield: 92%

m.p.: 86-88°C

- 20 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.21(3H,s), 2.24(3H,s), 2.92(4H,t), 3.06(3H,s), 3.31(4H,t), 3.75(6H,s), 3.83(3H,s), 6.00(3H,m), 6.71(1H,s), 6.83(1H,s)

Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>31</sub>N<sub>3</sub>O<sub>4</sub> 413.2314, found 413.2293

25 Example 191

1-[N-(4,5-Dimethyl-2-methoxyphenyl)-N-methylaminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 190

- 30 to obtain the titled compound.

yield: 90%

m.p.: 137-138°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.15(3H,s), 2.24(9H,s), 2.88(4H,t), 3.06(3H,s), 3.29(4H,t), 3.83(3H,s), 6.45(3H,m), 6.71(1H,s), 6.83(1H,s)

- 35 Mass(EI) m/z : Calcd for C<sub>23</sub>H<sub>29</sub>N<sub>3</sub>O<sub>2</sub> 381.2416, 381.2436

- 90 -

## Example 192

1-[N-(4,5-Dimethyl-2-methoxyphenyl)-N-methylaminocarbonyl]-4-(3,5-difluorophenyl)piperazine:

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-difluorophenyl)

- 5 piperazine was reacted by the same way with the example 190 to obtain the titled compound.

yield: 87%

m.p.: 98-100°C

- 10 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.16(3H,s), 2.25(3H,s), 2.92(4H,t), 3.06(3H,s), 3.29(4H,t), 3.83(3H,s), 6.23(3H,m), 6.72(1H,s), 6.83(1H,s)

## Example 193

1-[N-Ethyl-N-(4,5-dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

- 15 1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine(0.2g, 0.5mmole) was dissolved in dimethylformamide(15ml), and thereto sodium hydride(12mg, 0.5mmole) was added slowly. The resulting mixture was stirred at room temperature for 15 min. After iodoethane(78mg, 0.5mmol) was added, the resulting mixture was stirred
- 20 at room temperature for 16 hours. The resulting mixture was concentrated under the reduced pressure to remove the used solvent, extracted with methylene chloride, dried, filtered and purified by column chromatography to obtain the titled compound.

yield: 89%

- 25 m.p.: oil phase

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.09(3H,t), 2.16(3H,s), 2.24(3H,s), 2.75(4H,t), 3.28(4H,t), 3.52(2H,q), 3.75(6H,s), 3.81(3H,s), 5.98(3H,m), 6.70(1H,s), 6.80(1H,s)

## 30 Example 194

1-[N-(4,5-Dimethyl-2-methoxyphenyl)-N-ethylaminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-dimethyl

- phenyl)piperazine was reacted by the same way with the example 193
- 35 to obtain the titled compound.

yield: 93%



m.p.: 80-82°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.21(3H,t), 2.15(3H,s), 2.23(9H,s), 2.90(4H,t), 3.25(4H,t), 3.59(2H,q), 3.81(3H,s), 6.45(3H,m), 6.69(1H,s), 6.81(1H,s)

5 Example 195

1-[N-(4,5-Dimethyl-2-methoxyphenyl)-N-ethylaminocarbonyl]-4-(3,5-difluorophenyl)piperazine:

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-difluorophenyl)piperazine was reacted by the same way with the example 193 to

10 obtain the titled compound.

yield: 87%

m.p.: oil phase

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.09(3H,t), 2.16(3H,s), 2.25(3H,s), 2.90(4H,t), 3.27(4H,t), 3.52(2H,q), 3.81(3H,s), 6.24(3H,m), 6.70(1H,s), 6.81(1H,s)

15

Example 196

1-[N-Isopropyl-N-(4,5-dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-difluorophenyl)piperazine:

1-[(4,5-Dimethyl-2-methoxyphenyl)aminocarbonyl]-4-(3,5-difluorophenyl)

20 piperazine(0.2g, 0.52mmole) was dissolved in dimethylformamide(15ml) and thereto sodium hydride(12.48mg, 0.52mmole) was slowly added. The resulting mixture was stirred at room temperature for 15 min. After 2-iodopropane(87.88mg, 0.52mmole) was added thereto, the resulting mixture was stirred at room temperature for 16 hours. The resulting

25 mixture was concentrated under the reduced pressure to remove the used solvent, extracted with methylene chloride, dried, filtered and purified by column chromatography to obtain the titled compound.

yield: 84%

m.p.: oil phase

30 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.10(3H,s), 1.26(3H,s), 2.20(3H,s), 2.25(3H,s), 2.86(4H,t), 3.26(4H,t), 3.77(3H,s), 4.25(1H,m), 6.17(3H,m), 6.68(1H,s), 6.82(1H,s)

Example 197

35 1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

- 92 -

(a) Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate:

To 3,4-dimethyl-2-methoxyaniline(4.50g, 0.03mol), methylene chloride(100ml) was added and then phenyl chlorothionoformate(5.16g, 0.03mol) was added slowly. The resulting mixture was stirred for 2

5 hours, and thereto water(150ml) was added. The resulting mixture was extracted with methylene chloride and purified by column chromatography to obtain the titled compound.

yield: 92%

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.21(3H,s), 2.25(3H,s), 3.85(3H,s),

10 6.80(1H,s), 6.93(5H,m), 7.31(1H,s)

(b) 1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate(0.2g, 0.7mmol) and 1-(3,5-dimethoxyphenyl)piperazine(0.16g, 0.7mmol) were dissolved in

15 tetrahydrofuran(10ml) and thereto DBU(0.11g, 0.7mmole) was added, followed by stirring at room temperature for 2 hours. The resulting product was concentrated and purified by chromatography to obtain the titled compound.

yield: 84%

20 m.p.: 128-129°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.24(3H,s), 2.32(6H,s), 3.37(4H,t), 3.83(3H,s), 4.08(4H,t), 6.69(3H,m), 7.39(1H,m), 7.47(1H,s)

Mass(EI) m/z : Calcd for C<sub>22</sub>H<sub>29</sub>N<sub>3</sub>O<sub>3</sub>S<sub>1</sub> 415.1929, found 415.1912

25 Example 198

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and

1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the  
30 example 197 to obtain the titled compound.

yield : 90%

m.p.: 164-165°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.24(3H,s), 2.32(6H,s), 3.37(4H,t), 3.83(3H,s), 4.08(4H,t), 6.69(3H,m), 7.39(1H,m), 7.47(1H,s)

35 Mass(EI) m/z : Calcd for C<sub>22</sub>H<sub>29</sub>N<sub>3</sub>O<sub>1</sub>S<sub>1</sub> 383.2031, found 383.2086

## Example 199

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(2,3-dimethylphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and

- 5 1-(2,3-dimethylphenyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

yield: 89%

m.p.: 151-152°C

- 10 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.21(3H,s), 2.24(3H,s), 2.29(6H,s), 3.03(4H,t), 3.83(3H,s), 4.10(4H,t), 6.69(1H,s), 6.97(2H,m), 7.11(1H,t)

## Example 200

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(3,5-difluorophenyl)piperazine:

- 15 Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and 1-(3,5-difluorophenyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

yield : 92%

m.p.: 167-168°C

- 20 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.24(3H,s), 2.27(3H,s), 2.32(3H,s), 3.39(4H,t,J=5.0Hz), 3.83(3H,s), 4.14(4H,t), 6.70(1H,s), 6.80(2H,m), 7.36(1H,s), 7.44(1H,s)

## Example 201

- 25 1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(3,5-dichlorophenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and

1-(3,5-dichlorophenyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

- 30 yield: 85%

m.p.: 188-189°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.24(3H,s), 3.35(4H,t,J=5.0Hz), 3.83(3H,s), 4.04(4H,t,J=5.0Hz), 6.70(2H,m), 6.83(1H,s), 7.30(1H,s), 7.48(1H,s)

- 35 Mass(EI) m/z : Calcd for C<sub>20</sub>H<sub>24</sub>N<sub>3</sub>O<sub>2</sub>Cl<sub>2</sub> 423.0938, 423.0956

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## Example 202

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(2-fluorophenyl)  
piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and

- 5 1-(2-fluorophenyl)piperazine were reacted by the same way with the  
example 197 to obtain the titled compound.

yield: 87%

m.p.: 139-140°C

- 10 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.21(3H,s), 2.24(3H,s), 3.40(4H,t),  
3.83(3H,s), 4.25(4H,t), 6.70(1H,s), 7.13(3H,m), 7.37(2H,m)

## Example 203

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(2-chlorophenyl)  
piperazine:

- 15 Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and  
1-(2-chlorophenyl)piperazine were reacted by the same way with the  
example 197 to obtain the titled compound.

yield: 85%

m.p.: 115-116°C

- 20 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.21(3H,s), 2.24(3H,s), 3.18(4H,t),  
3.83(3H,s), 4.09(4H,t), 6.69(1H,s), 7.05(2H,m), 7.33(1H,s), 7.41(2H,m)

## Example 204

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-  
25 (2-methoxyphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and

1-(2-methoxyphenyl)piperazine were reacted by the same way with the  
example 197 to obtain the titled compound.

yield: 90%

- 30 m.p.: oil phase

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.23(3H,s), 3.14(4H,t,J=5.0Hz),  
3.82(3H,s), 3.88(3H,s), 4.06(4H,t,J=5.0Hz), 6.69(1H,s), 6.94(3H,m),  
7.30(1H,s), 7.40(1H,s)

- 35 Example 205

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-

- 95 -

(2-methylthiophenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and 1-(2-methylthiophenyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

5 yield: 93%

m.p.: 136-137°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.26(3H,s), 2.45(3H,s), 3.33(4H,t), 3.82(3H,s), 4.39(4H,t), 6.74(1H,s), 7.16(3H,m), 7.47(2H,m)

10 Example 206

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(3-hydroxyphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and 1-(3-hydroxyphenyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

15

yield: 77%

m.p.: Decomposed(200°C)

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.17(3H,s), 2.23(3H,s), 3.31(4H,t), 3.82(3H,s), 4.03(3H,t), 6.37(2H,m), 6.47(1H,d), 6.69(1H,s), 7.13(1H,t),

20 7.45(1H,s)

Example 207

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(2-phenoxyphenyl)piperazine:

25 Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and 1-(2-phenoxyphenyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

yield: 86%

m.p.: oil phase

30 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.17(3H,s), 2.24(3H,s), 3.19(4H,t), 3.80(3H,s), 3.85(4H,t), 6.66(1H,s), 6.91(2H,m), 6.98(1H,m), 7.05(3H,m), 7.13(1H,m), 7.23(1H,m), 7.31(2H,m), 7.36(1H,s)

Example 208

35 1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(2-isopropenylphenyl)piperazine:

- 96 -

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and 1-(2-isopropenylphenyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

yield: 75%

5 m.p.: 157-158°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.21(3H,s), 2.24(3H,s), 3.19(4H,t), 3.82(3H,s), 4.05(4H,t), 5.07(1H,s), 5.16(1H,s), 6.69(1H,s), 7.11(3H,m), 7.33(1H,s), 7.45(1H,s)

10 Example 209

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(2-methoxy-5-methylphenyl)piperazine:

Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and 1-(2-methoxy-5-methylphenyl)piperazine were reacted by the same way

15 with the example 197 to obtain the titled compound.

yield: 87%

m.p.: oil phase

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.23(3H,s), 2.29(3H,s), 3.13(4H,t), 3.83(3H,s), 3.85(3H,s), 4.05(4H,t), 6.69(1H,s), 6.83(2H,m),

20 7.30(1H,s), 7.40(1H,s)

Example 210

1-[(4,5-Dimethyl-2-methoxyphenyl)aminothiocarbonyl]-4-(1-naphthyl)piperazine:

25 Phenyl N-(4,5-dimethyl-2-methoxyphenyl)thiocarbamate and 1-(1-naphthyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

yield: 87%

m.p.: 139-140°C

30 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.23(3H,s), 2.24(3H,s), 3.21(4H,t), 3.84(3H,s), 4.09(4H,t), 6.70(1H,s), 7.10(1H,d), 7.48(5H,m), 7.85(1H,m), 8.22(1H,d)

Example 211

35 1-[(5-Acetyl-2-methoxy-4-methylphenyl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

- 97 -

Phenyl N-(5-acetyl-2-methoxy-4-methylphenyl)carbamate and 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

yield: 91%

5 m.p.: 103-105°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.54(3H,s), 2.59(3H,s), 3.27(4H,t), 3.70(4H,t), 3.79(6H,s), 3.94(3H,s), 6.13(3H,m), 6.70(1H,s), 7.05(1H,s), 8.72(1H,s)

Example 212

10 1-[(5-Acetyl-2-methoxy-4-methylphenyl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

Phenyl N-(5-acetyl-2-methoxy-4-methylphenyl)carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

15 yield : 88%

m.p.: 140-142°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.30(3H,s), 2.54(3H,s), 2.59(3H,s), 3.26(4H,t), 3.70(4H,t), 3.97(3H,s), 6.61(3H,m), 6.70(1H,s), 7.06(1H,s), 8.72(1H,s)

20

Example 213

1-[(5-Acetyl-2-methoxy-4-methylphenyl)aminocarbonyl]-4-(3,5-dichlorophenyl)piperazine:

Phenyl N-(5-acetyl-2-methoxy-4-methylphenyl)carbamate and

25 1-(3,5-dichlorophenyl)piperazine were reacted by the same way with the example 170 to obtain the titled compound.

yield: 78%

m.p.: 170-172°C

30 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.54(3H,s), 2.59(3H,s), 3.32(4H,t), 3.74(4H,t), 3.94(3H,s), 6.69(1H,s), 6.86(3H,m), 7.04(1H,s), 8.69(1H,s)

Example 214

1-[[5-(1-Hydroxyethyl)-2-methoxy-4-methylphenyl]aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

35 1-[(5-Acetyl-2-methoxy-4-methylphenyl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine(0.2g, 0.47mmol) was dissolved in

- 98 -

anhydrous ethanol(15ml), and sodium borohydride(17mg) was added thereto, and then the resulting mixture was stirred at room temperature for 2 hours, concentrated under the reduced pressure to remove ethanol, and purified by column chromatography(ethylacetate:hexane = 1:2) to

5 obtain the titled compound.

yield: 96%

m.p.: 152-154°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.41(3H,d), 2.32(3H,s), 3.27(4H,t), 3.71(4H,t), 3.79(6H,s), 3.87(3H,s), 5.04(1H,q), 6.10(3H,m), 6.63(1H,s),

10 7.01(1H,s), 8.22(1H,s)

#### Example 215

1-([5-(1-Hydroxyethyl)-2-methoxy-4-methylphenyl]aminocarbonyl)-4-(3,5-dimethylphenyl)piperazine:

15 1-[(5-Acetyl-2-methoxy-4-methylphenyl)aminocarbonyl]-4-

(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 214 to obtain the titled compound.

yield: 96%

m.p.: 140-142°C

20 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.48(3H,d), 2.33(3H,s), 3.26(4H,t), 3.68(4H,t), 3.87(3H,s), 5.06(1H,q), 6.61(3H,m), 6.64(1H,s), 7.01(1H,s), 8.22(1H,s)

#### Example 216

25 1-[(2-Methoxy-4-methyl-5-vinylphenyl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

1-([5-(1-Hydroxyethyl)-2-methoxy-4-methylphenyl]aminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine(0.2g, 0.47mmol) was dissolved in chloroform(15ml), pyridium p-toluenesulfonate(0.12g, 0.47mmol) was

30 added thereto, and the resulting mixture was refluxed for 16 hours, and concentrated under the reduced pressure to remove chloroform and purified by column chromatography(ethylacetate:hexane=1:2) to obtain the titled compound.

yield: 84%

35 m.p.: 163-165°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.31(3H,s), 3.23(4H,t), 3.58(4H,t), 3.77(6H,s),



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3.87(3H,s), 5.20(1H,d), 5.62(1H,d), 6.59(3H,m), 6.63(1H,s), 6.88(1H,t),  
6.99(1H,s), 8.32(1H,s)

## Example 217

- 5 1-[(2-Methoxy-4-methyl-5-vinylphenyl)aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine:  
1-[[5-(1-Hydroxyethyl)-2-methoxy-4-methylphenyl]aminocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 216 to obtain the titled compound.

10 yield: 82%

m.p.: 201-203°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.29(6H,s), 2.34(3H,s), 3.24(4H,t), 3.68(4H,t),  
3.87(3H,s), 5.22(1H,d), 5.66(1H,d), 6.59(3H,m), 6.63(1H,s), 6.86(1H,t),  
7.02(1H,s), 8.32(1H,s)

15

## Example 218

1-[(5-Acetyl-2-methoxy-4-methylphenyl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

Phenyl N-(5-acetyl-2-methoxy-4-methylphenyl)thiocarbamate and

- 20 1-(3,5-dimethoxyphenyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

yield: 82%

m.p.: 163-165°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.16(3H,s), 2.56(3H,s), 3.35(4H,t),

- 25 3.91(6H,s), 4.03(3H,s), 4.13(4H,t), 6.06(3H,m), 6.73(1H,s), 8.62(1H,s)

## Example 219

1-[(5-Acetyl-2-methoxy-4-methylphenyl)aminothiocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

- 30 Phenyl N-(5-acetyl-2-methoxy-4-methylphenyl)thiocarbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

yield: 79%

m.p.: 180-182°C

- 35 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.29(6H,s), 2.57(6H,s), 3.32(4H,t),  
3.92(3H,s), 4.12(4H,t), 6.56(3H,m), 6.72(1H,s), 7.39(1H,s), 8.63(1H,s)

## Example 220

1-[(5-Acetyl-2-methoxy-4-methylphenyl)aminothiocarbonyl]-4-(3,5-dichlorophenyl)piperazine:

- 5 Phenyl N-(5-acetyl-2-methoxy-4-methylphenyl)thiocarbamate and 1-(3,5-dichlorophenyl)piperazine were reacted by the same way with the example 197 to obtain the titled compound.

yield: 79%

m.p.: 201-203°C

- 10 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.20(3H,s), 2.57(3H,s), 3.46(4H,t), 3.92(3H,s), 4.25(4H,t), 6.64(1H,s), 6.88(3H,m), 7.72(1H,s), 8.57(1H,s)

## Example 221

1-[(5-(1-Hydroxyethyl)-2-methoxy-4-methylphenyl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

- 15 1-[(5-Acetyl-2-methoxy-4-methylphenyl)aminothiocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine was reacted by the same way with the example 214 to obtain the titled compound.

yield: 94%

- 20 m.p.: 146-148°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.44(3H,d), 2.32(3H,s), 3.35(4H,t), 3.78(6H,s), 3.84(3H,s), 4.11(4H,t), 5.06(1H,q), 6.13(3H,m), 6.66(1H,s), 7.41(1H,s), 7.77(1H,s)

## 25 Example 222

1-[(5-(1-Hydroxyethyl)-2-methoxy-4-methylphenyl)aminothiocarbonyl]-4-(3,5-dimethylphenyl)piperazine:

- 1-[(5-Acetyl-2-methoxy-4-methylphenyl)aminothiocarbonyl]-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the  
30 example 214 to obtain the titled compound.

yield: 93%

m.p.: 150-152°C

- 35 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.44(3H,d), 2.29(6H,s), 2.32(3H,s), 3.30(4H,t), 3.84(3H,s), 4.07(4H,t), 5.06(1H,q), 6.61(3H,m), 6.66(1H,s), 7.38(1H,s), 7.79(1H,s)

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## Example 223

1-([5-(1-Hydroxyethyl)-2-methoxy-4-methylphenyl]aminothiocarbonyl)-4-(3,5-dichlorophenyl)piperazine:

- 1-([5-Acetyl-2-methoxy-4-methylphenyl]aminothiocarbonyl)-4-(3,5-dichlorophenyl)piperazine was reacted by the same way with the example 214 to obtain the titled compound.

yield: 77%

m.p.: 166-168°C

- <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.45(3H,d), 2.33(3H,s), 3.35(4H,t), 3.84(3H,s), 4.03(4H,t), 5.07(1H,q), 6.68(3H,m), 6.83(1H,s), 7.37(1H,s), 7.82(1H,s)

## Example 224

- Ethyl 2-([4-(3,5-dimethoxyphenyl)piperazino]carbonyl)-2-methoxy-4,5-dimethylanilino)acetate :

- 1-([4,5-Dimethyl-2-methoxyphenyl]aminocarbonyl)-4-(3,5-dimethoxyphenyl)piperazine(0.2g, 0.5mmol) was dissolved in dimethylformamide(15ml), sodium hydride(18.5mg, 0.5mmol) was added thereto, and the resulting mixture was stirred at room temperature. Then, ethyl bromoacetate(83.5mg, 0.5mmol) was added thereto and the resulting mixture was stirred for 3 hours, concentrated under the reduced pressure to remove the used solvent and purified by column chromatography(ethylacetate:hexane=1:2) to obtain the titled compound.

yield: 79%

- m.p.: oil phase

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.36(3H,t), 2.15(3H,s), 2.23(3H,s), 2.91(4H,t), 3.22(4H,t), 3.82(6H,s), 4.12(3H,s), 4.18(2H,s), 5.98(3H,m), 6.69(1H,s), 7.03(1H,s)

- Example 225

Ethyl 2-([4-(3,5-dimethylphenyl)piperazino]carbonyl)-2-methoxy-4,5-dimethylanilino)acetate :

- 1-([4,5-Dimethyl-2-methoxyphenyl]aminocarbonyl)-4-(3,5-dimethylphenyl)piperazine was reacted by the same way with the example 224 to obtain the titled compound.
- yield: 78%

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m.p.: oil phase

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 1.26(3H,t), 1.56(6H,s), 2.17(3H,s),  
2.24(3H,s), 3.32(4H,t), 3.52(4H,t), 3.82(3H,s), 4.15(2H,q), 4.18(2H,s),  
6.70(3H,m), 6.94(1H,s), 7.46(1H,s)

5

#### Example 226

2-([4-(3,5-Dimethoxyphenyl)piperazino]carbonyl)-2-methoxy-4,5-  
dimethylanilino)acetic acid:

10 Ethyl 2-([4-(3,5-dimethoxyphenyl)piperazino]carbonyl)-2-methoxy-4,5-  
dimethylanilino)acetate(200mg, 0.41mmole) was dissolved in  
dioxane:distilled water(4:1, 15ml), lithium hydroxide monohydrate(50.7mg,  
1.23mmol) was added thereto, and then the resulting mixture was  
stirred at room temperature for 3 hours, acidified with 1N-hydrochloric  
acid, extracted with ethylacetate, filtered to dryness, concentrated under  
15 the reduced pressure to remove the used solvent, and purified by  
column chromatography(ethylacetate:hexane=1:2) to obtain the titled  
compound.

yield: 80%

m.p.: 188-189°C

20 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.14(3H,s), 2.23(3H,s), 2.93(4H,t), 3.35(4H,t),  
3.75(6H,s), 3.87(3H,s), 4.18(2H,s), 5.96(3H,m), 6.71(1H,s), 7.71(1H,s)

#### Example 227

2-([4-(3,5-Dimethylphenyl)piperazino]carbonyl)-2-methoxy-4,5-  
25 dimethylanilino)acetic acid:

Ethyl 2-([4-(3,5-dimethylphenyl)piperazino]carbonyl)-2-methoxy-4,5-  
dimethylanilino)acetate was reacted by the same way with the example  
226 to obtain the titled compound.

yield: 78%

30 m.p.: 170-171°C

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.13(3H,s), 2.24(9H,s), 2.91(4H,t), 3.35(4H,t),  
3.83(3H,s), 4.18(2H,s), 6.45(3H,m), 6.70(2H,s), 6.80(1H,s)

#### Example 228

35 1-[(2-Hydroxy-4,5-dimethylphenyl)aminocarbonyl]-4-  
(3,5-dimethoxyphenyl)piperazine:

## (a) 4,5-Dimethyl-2-nitrophenol:

To 3,4-dimethylphenol(12.1g, 0.1mol), trifluoroacetic acid(250ml) was added, and in water bath sodium nitrite(12.4g, 0.18mol) was added slowly. The resulting mixture was stirred at room temperature for 14 hours and concentrated under the reduced pressure to remove trifluoroacetic acid, followed by addition of water(150ml), extracted with ether and purified by column chromatography to obtain the titled compound.

10 yield: 80%

$^1\text{H}$  NMR(500MHz,  $\text{CDCl}_3$ ):  $\delta$  2.23(3H,s), 2.29(3H,s), 6.93(1H,s), 7.84(1H,s)

## (b) 4,5-Dimethyl-2-hydroxyaniline:

15 To 4,5-dimethyl-2-nitrophenol(11.7g, 0.07mol), tetrahydrofuran(100ml) and ethanol(40ml) were added, and 10% palladium/activated carbon(0.57g) was added slowly, and then the mixture was hydrogenated for 5 hours. The reaction mixture was concentrated and chromatographed by the same way above to obtain the titled compound.

20 yield : 77%

$^1\text{H}$  NMR(500MHz,  $\text{CDCl}_3$ ):  $\delta$  2.11(6H,s), 6.56(2H,s)

## (c) Phenyl N-(4,5-dimethyl-2-hydroxyphenyl)carbamate:

To 4,5-dimethyl-2-hydroxyaniline(6.80g, 0.05mole), methylene chloride(100ml) was added and then phenyl chloroformate(8.0g, 0.05mole) was added slowly. After stirring for 2 hours, addition of water(150ml), extraction with methylene chloride and column chromatography gave the titled compound.

yield: 92%

30  $^1\text{H}$  NMR(500MHz,  $\text{CDCl}_3$ ):  $\delta$  2.17(6H,s), 6.74(1H,s), 7.15(5H,m), 7.31(1H,s)

## (d) Phenyl N-[2-(t-butyl dimethylsilyloxy)-4,5-dimethylphenyl]carbamate:

To a mixture of phenyl N-(4,5-dimethyl-2-hydroxyphenyl)carbamate (7.72g, 0.03mol) and imidazole(2.2g, 33mmol), methylene chloride(100ml) was added, and with stirring t-butyl dimethylsilylchloride(5.0g, 33mmole)

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was added. Then the mixture was stirred for 2 hours, and water(150ml) was added thereto. The resulting mixture was extracted with methylene chloride, dried, concentrated under the reduced pressure and purified by column chromatography to obtain the titled compound.

5 yield: 83%

$^1\text{H}$  NMR(500MHz,  $\text{CDCl}_3$ ):  $\delta$  0.27(6H,s), 0.98(9H,s), 2.17(6H,s), 7.12(5H,m), 7.30(2H,s)

(e) 1-[(2-Hydroxy-4,5-dimethylphenyl)aminocarbonyl]-4-

10 (3,5-dimethoxyphenyl)piperazine:

Phenyl N-[2-(t-butyldimethylsilyloxy)-4,5-dimethylphenyl]carbamate (0.17g, 0.5mmole) and 1-(3,5-dimethoxyphenyl)piperazine(0.13g, 0.6mmole) were dissolved in tetrahydrofuran(10ml), and thereto with stirring DBU(0.09g, 0.6mmole) was added, and the resulting mixture

15 was stirred for 2 hours, concentrated and chromatographed to obtain the titled compound.

yield: 87%

m.p.: 145-146°C

$^1\text{H}$  NMR(500MHz,  $\text{CDCl}_3$ ):  $\delta$  2.14(3H,s), 2.18(3H,s), 3.26(4H,t), 3.67(4H,t),  
20 3.79(6H,s), 6.07(3H,m), 6.40(3H,m), 6.67(1H,s), 6.82(1H,s), 8.87(1H,s)

Example 229

1-[(2-Hydroxy-4,5-dimethylphenyl)aminocarbonyl]-4-(3,5-dimethoxyphenyl)piperazine:

25 Phenyl N-[2-hydroxy-4,5-dimethylphenyl]carbamate and 1-(3,5-dimethylphenyl)piperazine were reacted by the same way with the example 228 to obtain the titled compound.

yield: 84%

m.p.: 160-162°C

30  $^1\text{H}$  NMR(500MHz,  $\text{CDCl}_3$ ):  $\delta$  2.13(3H,s), 2.17(3H,s), 2.31(6H,s), 3.26(4H,t), 3.75(4H,t), 6.73(3H,m), 6.81(1H,s), 8.86(1H,s)

Example 230

1-[(2-Hydroxy-4,5-dimethylphenyl)aminocarbonyl]-4-(3,5-difluorophenyl)piperazine:

35 Phenyl N-[2-hydroxy-4,5-dimethylphenyl]carbamate and

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1-(3,5-difluorophenyl)piperazine were reacted by the same way with the example 228 to obtain the titled compound.

yield: 80%

m.p.: 152-154°C

5 <sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.17(3H,s), 2.20(3H,s), 3.30(4H,t), 3.70(4H,t), 6.40(3H,m), 6.70(1H,s), 6.82(1H,s), 6.98(1H,s)

#### Example 231

10 1-[(2-hydroxy-4,5-dimethylphenyl)aminocarbonyl]-4-(3,5-dichlorophenyl) piperazine:

Phenyl N-(2-hydroxy-4,5-dimethylphenyl)carbamate and

1-(3,5-dichlorophenyl)piperazine were reacted by the same way with the example 228 to obtain the titled compound.

yield: 77%

15 m.p.: oil phase

<sup>1</sup>H NMR(500MHz, CDCl<sub>3</sub>): δ 2.15(3H,s), 2.20(3H,s), 3.32(4H,t), 3.69(4H,t), 6.29(3H,m), 6.69(1H,s), 6.81(1H,s), 8.65(1H,s)

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Antitumor activities of compounds of the present invention were tested in vitro against 5 kinds of human tumor cell lines and 2 kinds of leukemia tumor cell lines. The method and result of in vitro tests is as follows.

5

Experimental 1 : In vitro antitumor effect against human tumor cell lines.

- 10      A. Tumor cell line : A549      (human non-small lung cell)  
                                 SKOV-3      (human ovarian)  
                                 HCT-15      (human colon)  
                                 XF 498      (human CNS)  
                                 SKMEL-2      (human melanoma)

15      B. SRB Assay Method.

- a. Human solid tumor cell lines, A549(non-small lung cell),  
            SKMEL-2(melanoma), HCT-15(colon), SKOV-3(ovarian),  
            XF-498(CNS) were cultured at 37°C, in 5% CO<sub>2</sub> incubators using the  
20      RPMI 1640 media containing 10% FBS, while they were  
            transfer-cultured successively once or twice per week. Cell cultures  
            were dissolved in a solution of 0.25% trypsin and 3 mM CDTA  
            PBS(-) and then cells were separated from media which the cells were  
            stuck on.

25

- b.  $5 \times 10^3 \sim 2 \times 10^4$  cells were added into each well of 96-well plate and  
            cultured in 5% CO<sub>2</sub> incubator, at 37°C, for 24 hours.

- c. Each sample drug was dissolved in a little DMSO and diluted with  
30      the used medium to a prescribed concentration for experiments,  
            wherein the final concentration of DMSO was controlled below 0.5%.

- d. Medium of each well cultured for 24 hours as above b. was  
            removed by aspiration. Each 200  $\mu$ l of drug samples prepared in c. was  
35      added into each well and the wells were cultured for 48 hours. Tz(time  
            zero) plates were collected at the point of time drugs were added.



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e. According to the SRB assay method, cell fixing with TCA, staining with 0.4% SRB solution, washing with 1% acetic acid and elution of dye with 10mM Tris solution were carried out on Tz plates and culture-ended plates, and then, OD values were measured at 520 nm.

5

#### C. Calculation of result

a. Time zero(Tz) value was determined with measuring the SRB protein value at the point of time drugs were added.

10

b. Control value(C) was determined with the OD value of an well untreated with drug.

c. Drug-treated test value(T) was determined with the OD value of drug-treated well.

15

d. Effects of drugs were estimated with growth stimulation, net growth inhibition, net killing etc. calculated from Tz, C and T.

e. If  $T \geq T_z$ , cellular response function was calculated by  $100 \times (T - T_z) / (C - T_z)$ , and if  $T < T_z$ , by  $100 \times (T - T_z) / T_z$ . The results are shown in the next table 1.

20

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#### 35 D. Results.

It was found that compounds of the present invention have the

superior antitumor activities than those of cisplatin, one control, and equal to or higher antitumor activities than those of adriamycin, another control, against human solid cancer cell lines.

5 Table 1.

ED<sub>50</sub>= $\mu$ g/ml

Ex. No.	A549	SK-OV-3	SK-MEL-2	XF-498	HCT 15
4	0.007	0.022	0.007	0.94	0.093
5	0.71	0.96	0.60	>10.0	0.96
9	0.15	0.07	0.21	0.11	0.11
11	0.91	0.56	0.62	0.73	0.71
14	0.022	0.02	0.001	0.16	0.007
15	0.002	0.05	0.052	0.035	0.038
16	0.008	0.04	0.038	0.005	0.061
17	0.018	0.01	0.021	0.077	0.008
22	0.0009	0.006	0.027	0.0053	0.01
23	0.09	0.04	0.09	0.092	0.05
24	0.03	0.006	0.01	0.234	0.01
27	0.02	0.11	0.01	0.046	0.165
28	0.06	0.07	0.001	0.41	0.05
46	0.21	0.12	0.08	0.14	0.16
47	0.92	0.62	0.47	0.64	0.81
53	0.47	0.47	0.64	0.67	0.71
56	0.017	0.0027	0.01	0.013	0.045
57	0.27	0.15	0.18	0.22	0.25
63	0.04	0.1	0.11	0.03	0.07
64	0.42	0.56	0.52	0.23	0.37
73	0.01	0.0054	0.02	0.013	0.012
74	0.016	0.0138	0.02	0.026	0.021
75	0.19	0.09	0.09	0.13	0.12

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Ex. No.	A549	SK-OV-3	SK-MEL-2	XF 498	HCT 15
81	0.0032	0.0007	0.0107	0.0097	0.0054
82	0.0676	0.0249	0.0754	0.0479	0.0346
85	0.048	0.117	0.039	0.104	0.10
88	0.014	0.043	0.02	0.009	0.011
99	0.43	0.41	0.40	0.52	0.36
100	4.54	3.02	3.47	0.66	4.21
103	0.52	0.46	0.49	0.36	0.33
109	0.47	0.91	0.86	0.53	0.49
110	0.52	1.06	0.97	0.81	0.69
112	0.56	6.43	0.22	2.07	0.61
128	0.40	0.37	0.42	0.44	0.51
132	0.03	0.01	0.03	0.04	0.04
133	0.57	0.94	0.53	0.61	0.57
134	0.0009	0.0091	0.0086	0.002	0.0065
135	0.056	0.092	0.102	0.06	0.066
140	0.33	0.47	0.56	0.54	0.49
142	0.015	0.011	0.021	0.026	0.017
143	0.0004	0.0095	0.0121	0.0009	0.0108
147	0.031	0.092	0.024	0.466	0.18
148	0.01	0.07	0.03	0.05	0.05
151	0.004	0.008	0.007	0.007	0.037
152	0.18	0.37	0.2	0.26	0.44
156	0.06	0.10	0.09	0.06	0.07
157	0.000002	0.000002	0.000043	0.000245	0.000211
159	0.05	0.10	0.07	0.21	0.17

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	Ex. No.	A549	SK-OV-3	SK-MEL-2	XF 498	HCT 15
	171	0.000645	0.00372	0.003233	0.000572	0.001809
	172	0.0047	0.0097	0.0233	0.0086	0.0180
5	174	0.54	0.56	0.27	0.49	0.33
	177	0.52	0.39	0.17	0.12	0.09
	179	1.04	0.98	0.72	0.74	0.63
	183	0.42	2.27	1.17	1.41	2.09
10	184	0.28	0.34	0.17	0.12	0.20
	190	0.004	0.008	0.002	0.443	0.017
	191	0.09	0.28	0.06	0.47	0.40
	198	0.021	0.068	0.008	0.072	0.56
15	200	0.50	0.53	0.26	1.01	0.44
	201	0.014	0.053	0.049	0.026	0.071
	202	0.57	1.26	0.48	2.09	0.64
	206	0.47	0.54	0.52	0.70	0.38
20	Cisplatin	0.8184	0.7134	0.7147	0.7771	3.0381
	Adriamycin	0.0168	0.0176	0.0108	0.0250	1.6689

25

## Experimental 2.

In vitro antitumor effects against animal leukemia cells.

## A. Materials :

30

Tumor cell lines : L1210(mouse leukemia cell)

P388 (mouse lymphoid neoplasma cell)

## B. Method : Dye Exclusion Assay.

- 1) The concentrations of L1210 and P388 cells being cultured in  
 35 RPMI 1640 media containing 10% FBS were regulated to  $1 \times 10^6$   
 cells/ml.

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2) Sample drugs of respective concentrations diluted in the ratio of log doses were added into cell media, and cultured at 37°C, for 48 hours, in 50% CO<sub>2</sub> incubator, and then viable cell number was  
5 measured by dye exclusion test using trypan blue.

3) The concentration of sample compounds showing 50 % cell growth inhibition(IC<sub>50</sub>) compared with the control were determined and listed in the table 2 below.

10

\* REFERENCE

- 1) P. Skehan, R. Strong, D. Scudiero, A. Monks, J. B. McMahon, D. T. Vistica, J. Warren, H. Bokesch, S. Kenney and M. R. Boyd. : Proc. Am. Assoc. Cancer Res., 30, 612(1989).
- 15 2) L. V. Rubinstein, R. H. Shoemaker, K. D. Paull, R. M. Simon, S. Tosini, P. Skehan, D. Scudiero, A. Monks, J. Natl. Cancer Inst., 82, 1113(1990)
- 3) P. Skehan, R. Strong, D. Scudiero, J. B. McMahon, D. T. Vistica, J. Warren, H. Bokesch, S. Kenney and M. R. Boyd. : J. Natl. Cancer  
20 Inst., 82, 1107(1990)

C. Results

As the results of measurement of antitumor activities of compounds of the present invention against L1210 and P388 mouse  
25 cancer cells, it was found that the compounds tested have equal to or higher antitumor activities than those of the control drug, mitomycin C.

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Ex. No.	L1210	P388
8	0.9	0.4
12	0.2	-
13	0.5	-
14	0.3	-
15	0.3	0.4
16	0.5	0.3
17	1.2	0.8
24	0.5	0.5
49	1.5	-
56	0.2	0.2
57	1.8	1.2
60	1.1	-
63	0.5	0.3
64	1.9	1.4
69	-	0.5
71	-	0.07
72	-	0.9
73	0.2	0.04
74	0.5	0.4
76	-	0.4
77	-	0.5

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Ex. No.	L1210	P388
132	0.4	0.4
134	0.5	0.2
140	1.8	1.6
143	0.5	0.4
144	1.2	0.5
148	1.6	-
149	1.0	0.6
151	-	1.2
152	0.3	0.3
154	-	0.1
157	1.7	1.0
158	0.5	0.2
170	0.4	0.4
173	0.5	0.2
178	1.8	1.6
181	0.5	0.4
182	1.2	0.5
186	1.6	-
187	1.0	0.6
190	0.3	0.3
195	1.7	1.0
196	0.5	0.2
Mitomycin	1.6	1.1

## 35 Experimental 3.

\* In vivo antitumor effects against mouse leukemia P388 cells.

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## A. Material of experiment

BDF1 mice were used.

## B. Method of experiment

1) Leukemia P388 cells being transfer-cultured successively in  
5 DBA/2 mouse, were grafted into each mouse of a group comprising 8  
mice of 6 week old BDF1 mouse with the dose of  $1 \times 10^6$  cells/0.1ml.

2) Sample drugs were dissolved in PBS or suspended in 0.5%  
tween 80, and then injected into abdominal cavity of mouse at each  
10 prescribed concentration on days 1, 5, 9, respectively.

3) With observation everyday, survival times of tested mice were  
measured. Antitumor activities was determined in such a manner that  
the increasing ratio(T/C%) of average survival days of drug-treated  
15 groups compared with the control group was calculated using the  
mean survival times of each tested groups.

The results are shown at the next table 3.

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Ex. No.	Dose(mg/kg)	T/C(%)	Interval of administration
8	200	140.9	on days 1, 5, 9
	100	104.5	
15	25	150	nine everyday
	10	110	
16	50	165	nine everyday
	25	110	
22	100	150	nine everyday
	50	140	
	25	110	
56	200	227.3	on days 1, 5, 9
	100	140.9	
	50	118.2	
56	50	165.0	nine everyday
	25	145.0	
	10	140.0	
73	50	180.0	nine everyday
	25	150.0	
	10	140.0	
74	50	250.0	nine everyday
	25	150.0	
	10	140.0	

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	Ex. No.	Dose(mg/kg)	T/C(%)	Interval of administration
5	81	200	218.2	on day 1, 5, 9
		100	145.5	
		50	127.3	
10	81	50	210.0	nine everyday
		25	140.0	
		10	140.0	
15	82	100	127.3	on days 1, 5, 9
		50	100.0	
		25	110.0	
20	98	100	150.0	nine everyday
		50	110.0	
		25	110.0	
25	135	100	150.0	nine everyday
		50	110.0	
		25	100.0	
30	144	200	125.0	nine everyday
		100	110.0	
		50	110.0	
35	171	100	140.0	on days 1, 4, 8
		50	100.0	
		25	100.0	
	172	200	190.9	on days 1, 4, 8
		100	127.3	
		50	118.2	

\* REFERENCE

A. Goldin et al.: Euro. J. Cancer, 17, 129 (1981).

5 C. Result

Through in vivo experiments using P388 mouse cancer cells, significant antitumor effect of the compounds of examples were observed.

10

Experimental 4.

Acute toxicity test ( $LD_{50}$ ) : Litchfield-Wilcoxon method.

- 15 6 weeks old ICR mice(male  $30 \pm 2.0g$ ) were fed freely with solid feed and water at room temperature,  $23 \pm 1^\circ C$  and at humidity  $60 \pm 5\%$ . Sample drugs were injected into the abdominal cavities of mice, while each group comprises 6 mice. Observed during 14 days, external appearances and life or dead were recorded, and then, visible
- 20 pathogenies were observed from dead animals by dissection.  $LD_{50}$  value was calculated by Litchfield-wilcoxon method.
- The results are shown at the next table 4.

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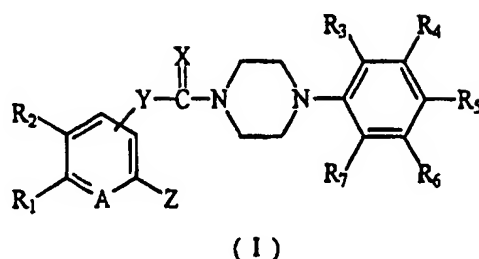
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	Ex. No.	LD <sub>50</sub> (mg/kg)(i.p)
	8	707
5	12	165
	13	284.8
	15	190
	16	282.8
10	22	>2,000
	28	>2,000
	56	410
	57	455
15	73	250
	74	361.4
	81	1,600
20	82	700
	170	573
	172	723
	182	348
25	184	309
	186	>2,000
	187	417.6
30	Cisplatin	9.7

As described above, it was found that the compounds of the present invention are more safer and have superior antitumor activities to cisplatin, and accordingly have solved the problems of drugs by the prior art such as restriction of dosage, toxicity, etc.

What is claimed:

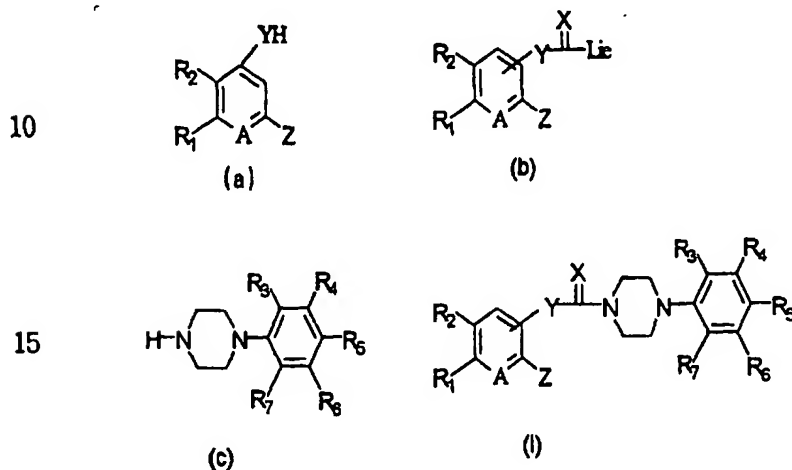
1. A compound of the general formula(I)



wherein  $R_1$  and  $R_2$  are independently hydrogen, substituted or unsubstituted  $C_1$ - $C_8$  alkyl, substituted or unsubstituted  $C_3$ - $C_6$  cycloalkyl, substituted or unsubstituted  $C_2$ - $C_8$  unsaturated alkyl, ketone, substituted or unsubstituted aryl, substituted or unsubstituted  $C_1$ - $C_4$  alkoxy, substituted or unsubstituted arylhydroxy, substituted or unsubstituted amino,  $C_1$ - $C_4$  lower ester,  $C_1$ - $C_4$  lower thioester, thiol, substituted or unsubstituted carboxyl, epoxy, substituted or unsubstituted  $C_1$ - $C_4$  lower thioalkoxy; or  $R_1$  and  $R_2$  are fused to form  $C_3$ - $C_4$  saturated or unsaturated chain;  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$  and  $R_7$  are independently hydrogen, halogen, hydroxy, nitro,  $C_1$ - $C_4$  lower ester,  $C_1$ - $C_4$  lower alkyl,  $C_1$ - $C_4$  lower thioalkyl, substituted or unsubstituted  $C_3$ - $C_6$  cycloalkyl,  $C_1$ - $C_4$  lower alkoxy,  $C_1$ - $C_4$  lower thioalkoxy, substituted or unsubstituted aryl, substituted or unsubstituted lower arylalkoxy, substituted or unsubstituted lower alkylamino, or lower alkyl substituted or unsubstituted carbamate; or among  $R_3$ ,  $R_4$ ,  $R_5$ ,  $R_6$  and  $R_7$ , two adjacent groups are bonded with each other to form 1,2-phenylene or 2,3-naphthylene; X is oxygen, sulfur, or substituted or unsubstituted imino; Y is bonded at the 3-position or 4-position of the aromatic ring part wherein Y is oxygen or  $-NR_8$ - (wherein,  $R_8$  is the same with the above-mentioned  $R_3$ ); Z is hydroxy,  $C_1$ - $C_4$  lower alkoxy,  $C_1$ - $C_4$  lower thioalkoxy, substituted or unsubstituted aryloxy,  $C_1$ - $C_4$  lower alkylamino, substituted or unsubstituted cycloamino containing 1-5 nitrogen atoms; A is nitrogen or  $-CH=$ ; and pharmaceutically acceptable acid addition salts thereof.

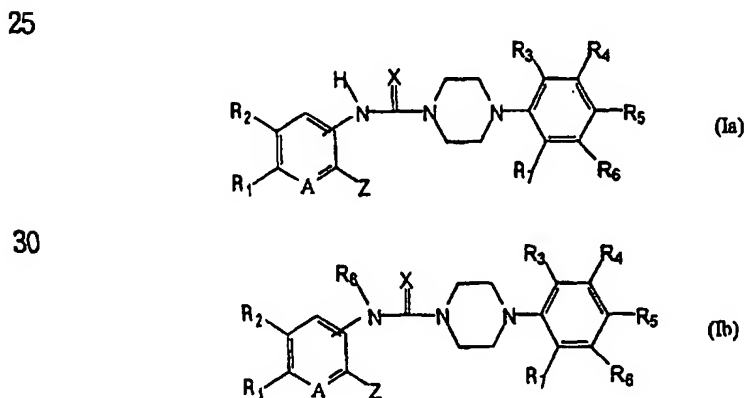
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2. A process for the preparation of compound of the general formula(I)  
or a pharmaceutically acceptable acid addition salt thereof comprising  
reacting a compound of the general formula(a) with a  $-C(=X)-$   
group-providing agent in the presence of organic solvent to obtain a  
5 compound of the general formula(b) and reacting the compound of the  
general formula(b) with a compound of the general formula(c).



wherein,  $R_1, R_2, R_3, R_4, R_5, R_6, R_7, A, X, Y$  and  $Z$  are as defined  
20 above and Lie is a leaving group .

3. A process for the preparation of compound of the general formula(Ib)  
by introducing  $R_8$  providing agent into a compound of the general  
formula(Ia).



35 wherein,  $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, A, X$  and  $Z$  are as defined above.

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